THE BOOK OF THE SAILBOAT

By A. Hyatt Verrill

The Real Story of the Whaler

The Book of the Sailboat

The Book of the Motor Boat

Isles of Spice and Palm

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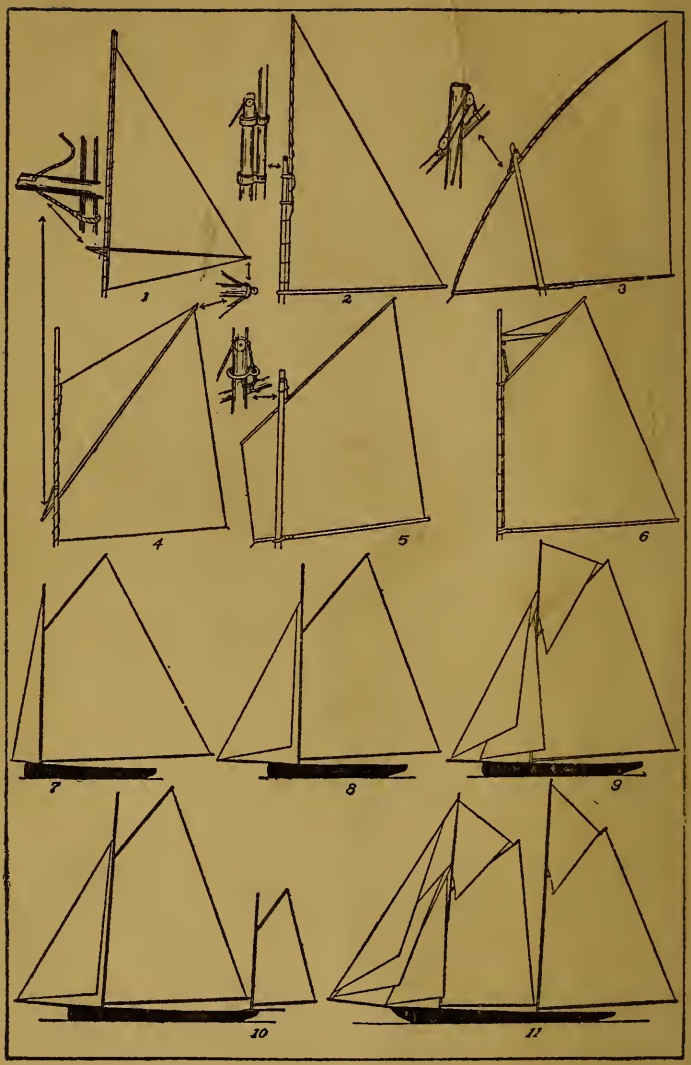

FORE-AND-AFT SAILS AND RIGS

1—Leg-o'-mutton sail. 2—Gunter sail. 3—Lateen sail. 4—Sprit sail. 5—Lug sail. 6—Boom-and-gaff sail. 7—Cat rig. 8—Jib-and-mainsail rig. 9—Sloop rig. 10—Yawl rig (Polemast). 11—Schooner rig (Polemast).

THE BOOK OF THE SAILBOAT

HOW TO RIG, SAIL AND HANDLE SMALL BOATS

BY

A. HYATT VERRILL

AUTHOR OF "THE BOOK OF THE MOTOR BOAT" "ISLES OF SPICE AND PALM," "THE REAL STORY OF THE WHALER"

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THE BOOK OF THE SAILBOAT

CHAPTER I

A SHORT HISTORY OF BOATS

No one knows who first invented boats. Probably they were used by primitive man long before he discovered how to use bows and arrows or had even learned to chip stones into simple tools and weapons. But those early boats were not boats as we know them today, for it has taken untold centuries for mankind to improve and develop boats to their present state of perfection. It was a natural and easy matter for a savage to straddle a floating log and, thus supported, cross some pond or stream, and when some member of the tribe discovered that two logs lashed together were more comfortable and less likely to roll over and dump their passengers into the water than a single log, he no doubt felt as if he had made a marvelous invention and was probably looked upon as a prehistoric Fulton by his fellowmen.

Later on some man found that a hollowed log was more buoyant and stable than an ordinary tree trunk and from this crude beginning rude dugout canoes

were developed. Even today many races have never progressed beyond the hollowed-log state of boat-building and dugouts, forty or fifty feet in length and capable of carrying great weights, are in daily use in many lands. Some of these are very crude, heavy craft, while others are beautifully made, are light in weight and are very speedy and seaworthy.

PRIMITIVE BOATS

1—Dugout made from a log. 2—Birch bark canoe. 3—Eskimo kyak made of skins. 4—Catamaran. 5—Turkish goofah. 6—East Indian balsa. 7—Malay proa.

Quite a different type of savage craft were the canoes of bark or skins. These may have been evolved from dugouts but it is more likely that accident or chance led to their discovery. A piece of floating bark bearing some wild animal or bird may have pointed the way toward the graceful birchbark canoes of the American Indians, while a stiff piece of dried

hide may have given the first hint of a kyak to the Eskimos.

However, it is useless to speculate upon the incidents that led our primitive and savage ancestors along the path to the shipyard for such matters are shrouded in the impenetrable mists of the dim and distant past. We know, however, that nearly every race possessed boats of one kind or another as long ago as there was any history and we know that the boats used thousands of years ago varied as greatly in construction, form, materials and other details as boats of today.

Strangely enough, many of the most primitive forms of boats are still in daily use. I have already mentioned dugouts, but birchbark canoes and kyaks are also used at the present time as widely as ever. It is evident that some of these prehistoric craft had been developed to the utmost point of perfection before the advent of civilization for many of them have never been improved upon. With all our knowledge we have never found any boat so well adapted to its purpose as the red man's canoe, and while we now make them of canvas instead of bark, we follow the same models as those used by the Indians centuries ago.

In certain parts of Great Britain the people still use the queer craft called *coracles* which Cæsar found the Britons using when his Roman legions invaded Albion, and although these curious boats, that look like the shell of a turtle or half of a walnut shell and are made of plaited willow, are among the most an-

cient forms of boats, yet the Welsh find them superior to modern boats in many ways. Somewhat similar are the *goofahs* of the Orient, circular, basket-like craft made of willow wands and covered with pitch which are used upon the Tigris and Euphrates and have not changed in the least since Bible days.

In the South Seas and other places the natives still use *catamarans* and *proas* which are really nothing but two logs fastened together, and yet the most efficient and safest of life rafts used by our greatest steamships are merely modifications of these same catamarans.

The purpose of any boat is to float and support its occupants while traveling across the water, and while it seems a far cry from the coracle or the dugout to a palatial steamship or a stately, four-masted, sailing ship, yet the principle of each is identical and each serves the purpose for which it was designed equally well; it is merely a matter of improvement, and many of the terms and names of parts which were used by the earliest sailors are still retained on our greatest liners and largest sailing vessels.

Starboard and *larboard,* for example, are merely corruptions of *steerboard* and *leeboard,* terms applied to the two sides of the ships of the Vikings and referring to the great steering oar on the right-hand side of the vessel and the board dropped over the opposite side to prevent the craft from making *leeway* or sliding sideways through the water. The *bowsprit* was originally a small spritsail spread to the vessel's bow; the *stern* was once the *steering;* the name *forecastle*

was given to the sailors' quarters when the deck-houses were literally *castles* in form, and we still speak of *cockpits* though we seldom stop to remember that the term was originally bestowed because this open portion of a boat resembled the circular areas wherein cockfights were held.

The enormous steel frames which support the great plates of a steamship's sides are still as much *ribs* to the sailor as the flimsy bits of wood bent into place by the naked savage building his frail canoe, and scores of the ropes, sails, rigging and other portions of a ship's fabric retain their ancient names in a similar manner. The seaman is the most conservative of beings and adheres to every time-honored custom, belief and habit and when the last sailor and the last wooden ship have disappeared many of the terms and ways that were dear to the heart of Jack Tar will still live on and be perpetuated for all time.

It is partly owing to this unwillingness on the part of the sailor to adopt anything new or unusual which has led to the survival of distinct forms of boats, for the seaman and boatman of every country believed the craft of his own waters to be superior to those of any other place. In rig, sail and other details each race of maritime people has preserved the traditions of their ancestors and even in neighboring localities we find boats which in form of hull, sails and rigging are absolutely distinct. Many of these are used only in one locality, one harbor or on one small island, but many others have been carried hither and thither and one can almost trace the history of a

country or the wanderings of its people by the types of boats used.

Of course, the first boats were propelled by hand, either by pushing them along with poles or by rough paddles, but even naked savages soon learned that they could let the wind work for them and raised mats, skins or even bushes to catch the breeze and waft them across the water. But it was many, many centuries before man learned that he could do away with oars entirely and could sail in any direction, regardless of the way the wind blew.

Even in the time of Columbus the ships could scarcely make headway against the wind and were more or less at the mercy of every passing breeze, but once sailors discovered the secret of sailing to windward the advance and improvement of ships and rigging was very rapid. The great, cumbersome, square sails of the earlier ships were divided into many pieces so as to be more readily handled and trimmed; triangular sails took the place of the picturesque spritsails on the vessels' bows; hulls were built lower and deeper and while the number of masts varied they were reduced until two- and three-masted, square-rigged vessels, known as *brigs* and *ships,* were the standard types of ocean-going craft.

Among smaller vessels there were sloops, luggers, ketches and other types of fore-and-aft-rigged craft, and as these sails had many advantages over the square sails and their awkward yards they replaced the latter in some cases and thus *barks, brigs* and *brigantines* came into use.

Then some brilliant sailor genius did away with the square sails altogether and a new type of vessel came into existence which was called a "schooner." But conservative, croaking Jack still pinned his faith to yards and square sails and for many years schooners carried lofty topsails of the same form as the upper sails of square-rigged ships.

Today the fore-and-aft-rigged vessels are more numerous than all other rigs combined and the square-riggers, stately and beautiful as they were—the handsomest vessels ever built by man—have been almost driven from the seas. With the outbreak of the European War and the demand for ocean-going cargo-carriers the old square-riggers have once more come to the fore, and in ports and harbors where a cross-yard mast had not been seen for many years, barks, ships and square-rigged vessels now line the docks and are an everyday sight. But they are only temporary and every boy and man who loves the sea and its ships should take advantage of this opportunity to view a passing type of vessels and should learn all about them, their rigging and their sails, for to them we owe much of our commerce and prosperity, our independence and our progress.

Although the cheaper, more easily handled and more simple schooners forced the square-rigged ships into the background, and while these in turn have been largely superseded by steam for deep-water voyages, yet the small boat has held its own throughout the centuries. In form, rig and other details the small boats of today vary as widely as ever, for small boats

are designed and used for specific purposes and no one can say which is the *best* boat or the *handiest* rig.

Steam and motor boats have taken the place of sailboats for business purposes in many places, but as long as men love the sea, as long as they enjoy the sting of the salt spray and the thrill of a plunging bow, as long as our eyes brighten and our pulses quicken as we grasp tiller and sheet and lee rails are awash, so long will the small boat hold its own. We may conquer distance by steam, we may annihilate time by paper-like hulls loaded with roaring motors of gigantic power, we may travel in floating palaces called yachts, but nothing will ever be made by man to take the place of the small boat for the out-and-out pleasure and perfect enjoyment it gives the true boat-lover.

Although there is an endless variety of hulls and rigs among small boats they may all be divided into a few general classes. In form of hull most boats may be grouped under two broad types: round-bottomed and flat-bottomed boats, but there *are* intermediate forms and there are also some kinds of boats which are a sort of hybrid or combination of both.

In rig we have the schooner, ketch, yawl, sloop and cat and while these cover the matter in a general way there is a wonderful variety in the sails, rigging and other details, and many boats which possess great advantages cannot be properly classed in any of these groups.

The best boat to use and the best rig to adopt depend largely upon the purpose of the boat and its

rig, the place where it is to be used, the owner's ability as a sailor, the weather likely to be encountered, the character of the neighboring shores and waters and various other conditions.

In order to select intelligently the best boat for your use it is necessary to consider the various types of hull and rig, their advantages and disadvantages and the purposes for which they are intended, and then, knowing these things, select the one which you think best adapted to your own requirements.

CHAPTER II

WHAT BOAT TO USE

Through countless centuries since man first made and used boats, an almost infinite variety of craft has been developed. In every land where boats of any sort are used the inhabitants have gradually evolved boats adapted to their special needs, the conditions of their seas or water courses and the work in which the boats are to be used.

In a great many countries the types of boats in use today have not changed or altered for hundreds of years, but in many other places forms, construction and other details of the boats have been changed, ideas from other lands or races have been adopted and we now find a great many different kinds of boats used for the same purpose. Moreover, with the migration of man from one place to another, boats of one nation have been introduced to the people of other lands and sometimes, in one locality, we may find boats from widely separated parts of the world being used daily side by side.

Of course these remarks apply mainly to boats used for commercial or business purposes for wherever boats are used for pleasure one may find an infinite variety of craft whose models have been culled from every corner of the maritime world.

In every case, however, there are certain definite reasons for one type of boat being more generally used than another, and every boat-builder and user, since boats were first invented, has aimed to combine certain qualities in the construction of boats.

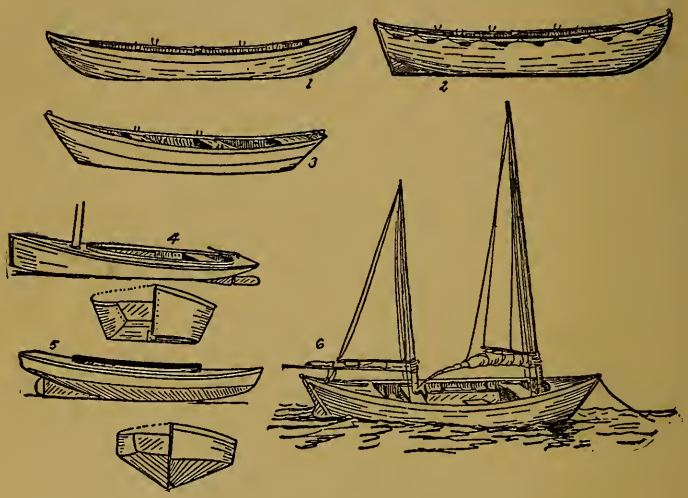
The three most important matters to be considered in any boat are seaworthiness, stability and speed. Which of these is of the greatest importance depends very largely upon the local conditions, the purposes for which the boat is to be used and the ideas of its builder or owner.

In some places speed is the prime consideration, in other places seaworthiness is the most important factor, while in still other localities the ability to carry heavy loads and not sink or upset is of more value than either speed or the power to resist winds and waves safely.

Thus the men who depend upon piloting vessels to an anchorage and whose earnings are large or small according to whether or not they reach the incoming vessels first, must have fast boats and seaworthiness may be a secondary consideration. Again the toilers of the sea who spend days upon the stormiest oceans fishing, lobstering or in similar pursuits must have boats which are safe in any weather and speed is of little importance, while those who use boats for

transporting heavy cargoes or many passengers from place to place in fairly smooth waters, find stability of greater value than either speed or seaworthiness.

Many times, however, in fact, as a general rule, the most seaworthy boats are the most stable, while usually both stability and seaworthiness must be sacrificed



TYPES OF SMALL BOATS ADAPTED TO SPECIAL USES

1—Whaleboat. 2—Lifeboat. 3—Dory. 4—Sharpie. 5—Skipjack. 6—Block Island boat.

to a certain degree in order to obtain great speed. But there are exceptions to all rules and many boats have become world-famous because they combine all these three qualifications to a remarkable degree.

The *whaleboats* used by the Yankee whalemen for chasing and capturing whales, are splendid examples of this. These boats are light, strong, stable, sea-

worthy and very fast and in these respects are probably the most perfect type of small craft ever designed. They are thirty feet in length and six feet wide, barely two feet in depth amidships and yet are capable of breasting the heaviest waves of midocean, withstanding the most terrific gales and weathering the most severe storms of any seas. Pulled by five oars they attain the speed of a motor boat; they are light enough to be pulled upon a beach or easily hoisted to a ship's davits. They sail rapidly, are easily handled and hold together when towed at express-train speed by a harpooned whale.

Moreover, their construction is so simple that even when smashed or "stove" by a whale they can be repaired easily by a carpenter and best of all they are very cheap, a new whaleboat costing complete only one hundred and twenty-five dollars. In these boats shipwrecked whalers have made some marvelous voyages and several instances are on record of men navigating the stormiest parts of the ocean for six thousand miles in these boats in perfect safety.

Somewhat similar to the whaleboats in shape are the *surfboats* used on the coasts of many sea-girt localities, notably on the Atlantic seaboard of our Middle States, and while not as speedy, light or staunch as the whaleboats, they ride the roaring surf and towering waves as buoyantly as seabirds and are ideal boats for use where there are heavy seas.

Lifeboats, such as those used on steamships and by the coast guard, are really modified whaleboats and surfboats, combining the good points of both and with

slight alterations in proportions and construction to enable them to carry large loads with safety.

They are not as easily handled or as speedy as the whaleboats, but they are far more roomy; they are almost non-capsizable, are unsinkable and are built both of metal and of wood. The are rather heavy, however, and expensive.

For one who wishes a perfectly safe, roomy, strong boat capable of withstanding almost any weather and with good sailing qualities it is hard to find anything better than a standard lifeboat.

At Block Island, off the tip of Long Island, there is a peculiar sort of boat used by the native fishermen, which is known as the *Block Island boat.* In some ways this craft resembles a whaleboat and in some ways it reminds one of a surfboat, while in many of its characters it is much like a lifeboat and yet it is totally different from all. They are wonderfully staunch and seaworthy, they have great carrying capacity and sail very well. Formerly a great many were used as small cruising yachts, but of late years they have almost disappeared.

Somewhat similar to the whaleboats are the big *seine boats* used by the New England fishermen for pulling the great, heavy seines when catching mackerel, herring, menhaden, etc. They are very stable boats with immense carrying capacity, are easily handled and are seaworthy, but have no advantages over the whaleboats except in point of size. They do not sail as well nor are they are as seaworthy as the whaleboats.

All of the above are round-bottomed boats of the double-ended type in which both bow and stern are sharp. One would therefore assume that this style was the most seaworthy, especially as the spongers of the Mediterranean, the pilot boats of many islands and the typical fishing-boats of the European countries are also double-ended. Such, however, is not necessarily the case for the fishermen, pilots and other inhabitants of other countries use round-bottomed boats with broad sterns and some even use flat-bottomed boats and brave as heavy weather, as hard storms and as tumultuous seas as their fellows in the round-bottomed, double-ended craft.

Probably no men in the world ply their trade in rougher seas and in stormier weather than the Gloucester fishermen who fish for halibut and cod on the banks of Newfoundland and on George's Banks. The boats used by these hardy fishermen are known as *dories* and are flat-bottomed, high-sided, odd-looking craft which one would never imagine were seaworthy, yet in them the Gloucester fishermen ride out terrific storms and mountainous waves; they haul halibut weighing hundreds of pounds over the boats' sides without capsizing, and they sail or row them safely through winter storms in midocean when laden with fish until the gunwales are almost level with the water. Dories used by the fishermen are not beautiful nor graceful boats, but they are wonderfully well adapted to their use, and many builders have adopted so-called dory models for pleasure craft, both for motor boats and sailboats. As a rule, however, there is little re-

semblance between these "improved" dories and those of the banks, and the stability and other qualities of the real dories are usually lost in altering the lines for the sake of appearances.

Still another type of flat-bottomed boat which is used all along the Atlantic coast is the *sharpie*. The sharpie is merely a modified skiff equipped with a centerboard, but when properly handled these boats will stand a great deal of rough weather and knocking about and, moreover, they sail remarkably well. One usually thinks of sharpies as small boats but they are often forty or fifty feet in length and are sometimes built as large as small schooners and of twenty to fifty tons capacity. The great objection to sharpies and other flat-bottomed boats is that they "pound" or slap the water when in a heavy sea or among choppy waves, and to overcome this a type of boat known as a *skipjack* was evolved. Skipjacks are a sort of connecting link between true flat-bottomed and round-bottomed boats, for the after part of the bottom is flat while the forward portion is V-shaped and thus they cut through the seas instead of pounding on them while at the same time they slip over the surface of the water rather than through it. Many of the fastest racing boats and the fastest motor speed boats are nothing more nor less than modified skipjacks, and for all-around use, especially in shallow waters, there are few better boats where roominess and sea-going qualities are not essential.

Just as the men whose living depends upon their boats have agreed upon the craft best suited to their

needs, so the man or boy who is selecting a sailboat for pleasure should consider all the types and should choose that which best fulfills all of his requirements.

If you want a roomy boat or a boat on which to live or sleep you should choose a round-bottomed craft, for only in these can you obtain much depth or "head room" unless a very high cabin is built above the deck which always makes a boat top-heavy and unseaworthy. If the waters in which you are to use your boat are stormy, if heavy seas are common, or if you expect to make long trips out to sea or from place to place, select a boat which is noted for its seaworthy qualities, such as a *whaleboat, seine boat, lifeboat* or *Block Island model.*

If you are obliged to run ashore or to pull your boat upon a rocky or sandy beach select a flat-bottomed craft which can be hauled out readily without injury; while, if you want a boat for general utility, to use in bays and harbors and in sheltered waters and yet capable of standing any reasonable seas and ordinary storms, select a fairly deep, beamy, round-bottomed hull such as the *Cape Cod* or *Block Island cat-boat,* or a similar model.

If your boat is merely an open boat for day sailing and short trips almost any type will serve, such as a *dory,* a *sharpie,* a *skipjack* or a round-bottomed or *yawl* boat. As a rule, however, you should avoid the true "open" boat for sailing, for in a boat without any deck it only takes a slight puff of wind, an instant's carelessness or a small sea to bring the rail under water and swamp the boat.

Even a very narrow deck is far better than none at all and if the deck has a good high "combing" or raised inner edge, the safety will be increased a hundredfold.

Very few boats will capsize if decently handled and not equipped with too much sail unless "tripped" by getting water over the side; but once the rail of an open boat *is* under water the boat will upset very quickly, for each pound of water taken in stays on the lowest side of the boat and has a tendency to carry the craft over still further.

A great deal depends upon the construction of the boat itself and still more depends upon the rig or sails to be used, and before selecting or using any boat you should be thoroughly familiar with the various parts of a boat, its construction, its fittings and its rig and should know what each and every part is for, as well as how to use, repair and care for it.

CHAPTER III

PARTS OF BOATS

Nearly everyone knows that the body of the boat is called the hull, but a great many people, even those who live by the sea or who are accustomed to the use of boats, know very little about the various parts of the hull or the proper names for the different portions of it.

The principal parts of a small boat's hull are: the *bow,* the *stern,* the *deck* (if not an open boat); the *keel,* the *thwarts,* the *bilge,* the *bottom,* the *topsides* and the *gunwales.* Each of these is made up of various pieces or parts, and to portions of each different names are given. The *bow* is the forward end of the boat; the *stern* is the rear end; the *deck* is the portion on top or the part which covers the open portion; the *keel* is the very bottom piece which extends from bow to stern; the *thwarts* are the seats; the *bilge* is the bottom close to the keel on either side; the *bottom* proper is the portion between the keel and the sides of the boat; the *topsides* are the sides above the curve of the bot-

tom; the *gunwales* are the upper edges of the topsides.

The extreme forward edge of the bow is known as the *cutwater;* the extreme end of the stern is known as the *counter* or *transom;* the curve from bow to stern, horizontally, is called the *sheer;* the sides above the water are known as *freeboard;* the inner edge of the decks when provided with a perpendicular edge is the *combing;* the open space within the edge of the decks is known as the *cockpit;* the extreme forward portion of the boat is called the *peak;* the central part of the craft is the *waist;* the forward part of the hull near the stem and below the water line is the *entrance;* the after part, on the sides beneath the water is the *run.* In every boat, no matter how large or small she may be, these parts are always the same.

The various parts used in building a boat are very numerous in some craft and are few in others, depending upon the size and model of the boat, but in every case similar parts have the same names and are used for the same purposes.

The upright piece, to which the sides are attached at the bow is the *stem* and when this is made in two parts, as is often the case on large boats, the outer piece is known as the *false stem.* This stem is attached to the keel by a *knee* and when a second piece is attached to the keel to thicken and strengthen it, the piece is called the *keelson.* At the stern the upright timber is called the *sternpost* and to this the transom, the broad flat piece at the end of the stern, is fastened. From the stem to the transom extends the *planking,* the plank next to the keel on each side

being called the *garboard strake* and the ones at the top of the sides being known as *top strakes, sheer strakes* or *upper strakes.* From keel to the tops of the sides curved or bent pieces are fastened which are known as *ribs* and these are attached to the keel-piece and the decks by *knees.* Sometimes an inner lining is placed on top of the ribs to make the inside of the boat smooth and this is known as the *ceiling* while the pieces that extend across from side to side and which support the decks are called *deck timbers.* These are the principal parts found in every boat of round-bottomed construction, but in flat-bottomed boats there are no real ribs, no bilge nor garboard strakes, no keel and no real sternpost, owing to the form and method of construction.

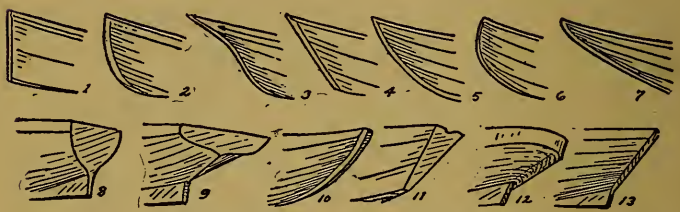
In a flat-bottomed boat the bottom runs across from side to side without any bilge; the entire sides are practically freeboard; straight braces or timbers replace ribs; the keel is replaced by a false keel or *rubbing strake* and, except in large sized boats, the transom is held in position by the sides and bottom and no stern post is required.

In form and design the various parts of boats vary as much, or even more, than the boats themselves and there is an almost endless variety of bows, sterns, counters, etc., not to mention the forms of rudders, the variations in sheer, and other proportions of form, lines, run, freeboard, etc.

Even in one type of boat there may be a great many forms of bows or sterns in use, many designed merely to add to the appearance of the craft, others to add

speed, others to make the boat drier, others to adapt it better to sailing or rowing, as the case may be; and still others to afford better facilities for using certain types of rig, gear or fishing-tackle.

The forms of bows and sterns are so numerous that to name or describe them all would require a volume, but they may all be grouped under a comparatively limited number of types, the others being merely modifications or combinations of these.



TYPES OF BOWS AND STERNS

1—Straight bow. 2—Round bow. 3—Clipper bow. 4—Dory bow. 5—Whaleboat bow. 6—Canoe bow. 7—Spoon bow. 8—Square stern. 9—Overhanging stern. 10—Whaleboat stern. 11—Dory stern. 12—Round stern. 13—Sharp or "pinkey" stern.

The commonest and most important forms of bows are as follows:

Straight bows, in which the stem is perpendicular to the keel; *round bows,* in which the stem is curved or rounded from keel to deck; *clipper bows,* in which the stem is concave or hollowed in outline; *raking* or *dory bows* in which the stem is set at an angle to the keel; *whaleboat bows* which are rounded or curved and are also at an angle; *canoe bows* which are like the round bows but more convex, and *spoon bows*

which have no true stem but sweep in a gradual curve from the bottom of the boat to the deck.

Among the more typical sterns we find: *Square* or *straight sterns,* in which the sternpost is perpendicular and the counter is broad and flat; *overhanging sterns,* in which the counter is carried out beyond the sternpost and overhangs the water; *dory sterns,* in which the sternpost is at an angle and has a V-shaped counter; *whaleboat sterns* which are sharp and shaped like the bow; *round sterns,* in which the sides are carried around in a curve or half-circle with no transom; and *sharp sterns* or *pinkey sterns* which are sharp like the stern of a whaleboat, but instead of being curved are merely angular or perpendicular.

Each of these forms of bows and sterns possesses qualities which adapt it to one purpose more than another and in selecting a boat you should bear this in mind. Straight or round bows throw a larger bow wave than the whaleboat or clipper types and have a tendency to bury the bows in heavy seas; whaleboat or dory bows cut through the waves, but give great buoyancy or lifting power to the craft, thus preventing it from burying the forward part in the water; while spoon bows pound and slap in heavy seas and are principally of value for racing boats or for use in calm waters.

Even the sterns have an important effect upon a boat's abilities and seaworthiness. A square stern will drag a great deal of water behind it when traveling rapidly and with a following sea is liable to take in water, or to be "pooped," as the sailors would say.

Round sterns with an overhang are also bad in a seaway and often make a boat slow in coming about or turning; transom sterns with an overhang are better, while the sharp-pointed pinkey or whaleboat sterns prevent a following sea from entering the boat and leave a clean wake, but owing to the fact that there is no overhang and that the entire height of the boat is brought broadside to the water when turning, they are not so quick in maneuvering as a stern with a good overhang. Perhaps the best all-around stern is one with a good overhang, a sharp run and a small counter: in other words, a sort of combination of the common overhand stern and the whaleboat type.

In the planking, boats vary a great deal, and there are many different methods of making the sides and bottom. Even boats of the same form, for the same uses and with the same style of bow and stern may be made in very different ways. One method is to place the planks so that the edges join and there is a uniform, smooth surface, with all the planks running from bow to stern. This is known as *smooth-skin* or *carvel planking*. Another style is to let the boards overlap slightly; this is known as *clinker construction* or *lap-streak* planking. Other boats are planked with very narrow strips fastened one above the other, edge to edge, while still others are covered with two or more layers of thin boards placed diagonally from keel to gunwales and known as *diagonal planking*. For light racing boats the latter type is admirable for it is strong, light, tight and stiff, but it is difficult to repair, it is expensive and for ordinary use has no

advantages. Clinker-built boats are excellent when new, but a broken or injured plank is difficult to replace, leaks are hard to stop and it has no advantages over the carvel planking which is the commonest of all forms of boat-building.

Still another matter to be considered when selecting a boat is whether you should use a keel or a centerboard craft. Every boat, in order to sail well, must have a portion which projects below the bottom and which will prevent the craft from sliding sideways or making "leeway" on the water when the wind is from the side or when sailing against the wind. This projection may be a *keel,* which is an immovable portion of the boat itself; it may be a *centerboard* which is a board which can be raised or lowered at will from the center of the boat, or it may be a *leeboard* which is merely hung over the side opposite the wind and is shifted as the boat tacks or goes about.

Leeboards are clumsy makeshifts and while they are used on large vessels in some countries, as in Holland and Scandinavia, they are a great nuisance and very unsatisfactory on anything but canoes and rowboats which are sailed occasionally and on which either keels or centerboards would be inconvenient.

No one has yet decided definitely whether or not keels or centerboards are the better, although the matter has been discussed, tried and thrashed out for years. As a matter of fact each has its advantages and disadvantages, each is adapted to certain types of boats and to certain conditions and each has its adherents who have no faith in the other type.

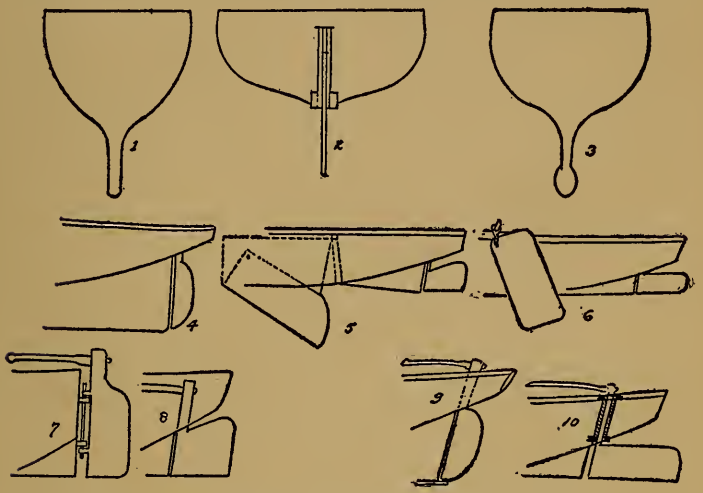
Personally, I think the keel boat the better for deep water use where there is a likelihood of heavy weather and yet many of the Gloucester fishing-smacks and many yachts which have won ocean races are of the centerboard type. For shallow waters or where there are reefs, sandbars, shoals or mud-flats keel boats are a nuisance and centerboards are practically a necessity. Where boats are to be hauled on beaches centerboard boats are really the only kind to use, for keel boats will not stand upright and cut deeply into the sand. Flat-bottomed boats are nearly always of the centerboard type; whaleboats have centerboards, and yet catboats and other round-bottomed boats are made in both types.

Keel boats are roomier than those with centerboards for there is no space occupied by the centerboard and its case; they are less liable to capsize, and if made with the same proportions as centerboard boats they are as dry, seaworthy and handy. As a rule, however, the keel craft are much narrower and deeper than those equipped with centerboards and many of them are almost like a plank set on edge. These are stable enough, but they are wet, uncomfortable and hard to handle.

The advantages of the centerboard are that when sailing before the wind or when rowing the board may be lifted and much less resistance to the water will then result and consequently more speed may be gained. When in shallow water the centerboard may be raised or lowered according to the depth of the water, and if a sandbar or reef is struck little injury will result, as

the board is free to move up when it strikes an obstruction, whereas a keel boat under the same conditions might be badly injured.

The objections to a centerboard are the difficulties in keeping the case and trunk of the board from leaking, the space it occupies, the necessity of raising or lowering it according to varying conditions and the



KEELS, CENTERBOARDS, LEEBOARDS AND RUDDERS

1—Section of a keel boat. 2—Section of a centerboard boat. 3—Section of a fin keel boat. 4—Portion of a keel boat's hull. 5—Boat with centerboard. 6—Boat with leeboard. 7–9—Forms of rudders for keel boats. 8–10—Forms of rudders for centerboard boats.

slight, very slight, chance of losing the board and thus becoming helpless.

Centerboards are not confined to small boats as many think, but large coasting vessels and even three-masted

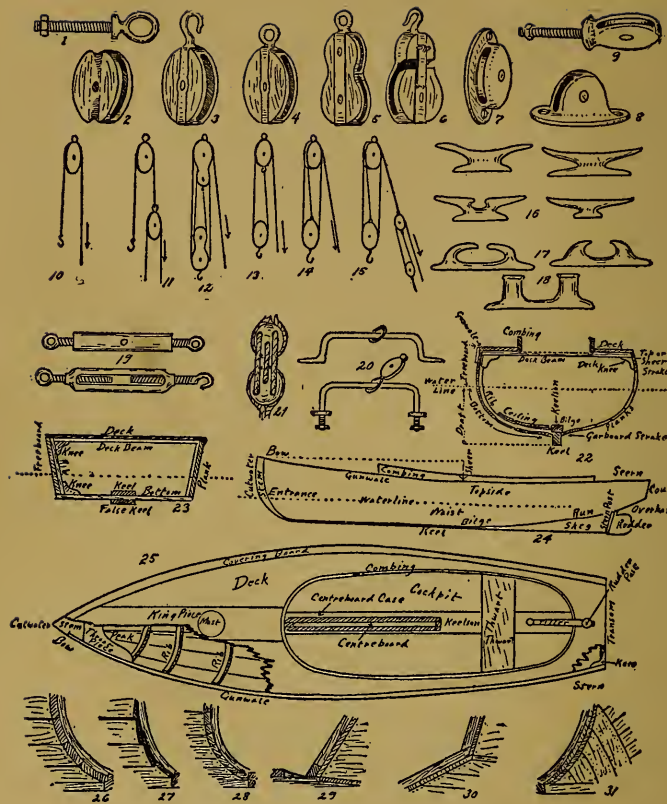
schooners are often built with them, which proves that they have many great advantages. Some boats are built in a sort of combination keel and centerboard method, in which a moderate keel is provided and a centerboard is used as well, while within comparatively recent years the *fin-keel* type of boat has been evolved. In these the hull is proportioned like that of a centerboard boat but the keel is merely a large fin or sheet of metal carrying a mass of lead or iron at its lower edge. All things being equal, the best boat for ordinary use is the centerboard type and for small boats, or the amateur's use, they are far superior to keel boats of any sort.

Most small boats are steered by means of a rudder and tiller, the rudder being a wooden or metal affair submerged at the stern and the tiller consisting of a handle at the rudder's upper end. Some rudders are hung or fastened to the counter and can be easily taken off or "unshipped," while others are under the counter and are fastened to the sternpost with the upper end coming up through the boat or the deck. There are various forms of rudders: some long and extending out for a considerable distance in the rear of the boat, and others high and narrow, but the purpose of all is the same and the rudder is always designed to present an area sufficient to swing the boat around readily or to steer it without using too great force. Large boats are usually steered by gears connecting the rudder to a wheel; as the handling of a tiller connected directly to the rudder of a large vessel would be a very difficult task indeed.

As, in order to turn a boat to the right, the tiller must be moved to the left, the terms used by sailors in steering boats are often confusing to landsmen. For example, if a sailor wants a boat turned to the left, or to *port,* as it's called, he will say. "Starboard the helm," or, in other words, push the tiller to the *starboard* or right-hand side, and vice versa. It is not so bad when steering with a tiller, but when steering with a wheel the beginner is very apt to do the wrong thing and turn the wheel *to the right* when he wants to go *to the right* and *to the left,* or *port,* when he wants to go to that direction, and to simplify matters many boats are now arranged so that the wheel is turned in the direction one really wants to go.

This makes it very easy when steering for oneself, but if someone is directing the course and sings out the orders in true sailor fashion the steersman has to remember and *port* his helm when he is told to *starboard* it and thus the confusion is just as bad as ever. For this reason the beginner should use a tiller if possible; for that matter, there is no advantage in a wheel in boats less than thirty or forty feet in length.

On every sailboat there are a certain number of appliances which are unfamiliar to landsmen but which you should become accustomed to before attempting to handle a boat. There are *blocks, tackle, chocks, fairleaders, cleats, turnbuckles, eyebolts* and *travelers* among the deck fittings. Each of these has its use and one should be perfectly familiar with them. *Blocks* are wooden or metal objects containing rollers or wheels known as *sheaves* through which ropes are



Boat Fittings and Parts of Boats

1—Eyebolt. 2—Block. 3—Hook block. 4—Ring block. 5—Sister or fiddle block. 6—Snatch block. 7—Cheek block. 8, 9—Fairleaders. 10—Whip purchase. 11—Whip and runner. 12—Long tackle. 13—Gun tackle. 14—Luff tackle. 15—Watch tackle. 16—Cleats. 17—Chocks. 18—Bitts. 19—Turnbuckles. 20—Travelers. 21—Dead eyes. 22—Section of boat to show parts (round bottom). 23—Section of boat to show parts (flat bottom). 24—External parts of boat. 25—Parts of boat (top view). 26—Carvel planking. 27—Clinker planking. 28—Strip planking. 29—Flat bottom planking. 30—V-bottom planking. 31—Diagonal planking.

run to enable them to be hauled tight without great friction. *Cheek-blocks* are half blocks which bolt or attach to a mast, spar, or other object. *Sister-blocks* have two sheaves, one above the other, in a single shell. *Tail-blocks* are blocks with a rope or hook at one end by which they may be hung to spars, etc. *Snatch-blocks* are blocks arranged so that one side may be opened to allow a rope to be passed over the sheave without running it through and there are *patent-blocks* which will hold a rope securely in any position by means of a grip.

Blocks and ropes together are known as *tackles* and the blocks used may be single, double, triple or fourfold, according to the number of sheaves they contain. A *luff-tackle* has a single and a double block with one end of the rope fast to the single block and the hauling end leading from the double block.

A *gun-tackle* consists of two single blocks with one end of the rope fast to the upper block and the hauling part passing down from the upper block.

A *watch-tackle* is a tackle used to haul the rope which is rove through another tackle and a *whip-purchase* has a single block only.

The purpose of the tackle is to increase one's power and the more sheaves there are and the more times the rope is passed through the blocks the more the power obtained; but as in every case where power is increased, speed is lost and to hoist a sail with a tackle with several sheaves requires more time than to do the same work with a single-sheave block. For this reason the simplest tackle which will enable you to per-

form the work without undue exertion is the one you should use.

Fairleaders are sheaves or rollers which are screwed or bolted to the decks or other parts of the boat and through which ropes are run in order that the ropes may be carried around curves or at right angles. *Chocks* are metal or wooden appliances in the form of notches and are used where ropes pass over the edge of a boat to hold them in one position. *Cleats* are devices for holding a rope without tying it and are very useful and numerous on boats. They are either of metal or wood and by winding the rope over them it may be held securely and yet can be thrown off at a moment's notice. *Turnbuckles* are metal arrangements for tightening ropes, wires or chains and have hooks or eyes at the ends with screw-threads which may be drawn together or separated by turning the central portion of the turnbuckle. On small boats they are seldom used, but on large and medium-sized craft they are very necessary. *Eyebolts* are eyes bolted or screwed in position and to them turnbuckles, ropes, blocks or other objects are fastened, while *travelers* are metal rods over which blocks, rings or things slide or "travel." *Travelers* are usually placed at the stern of single-sailed boats for the tackle of the sheet, the rope which controls the sail, to slide on, and they are also used on masts for the sail to slide up and down upon when it is raised or lowered, as well as in many other places.

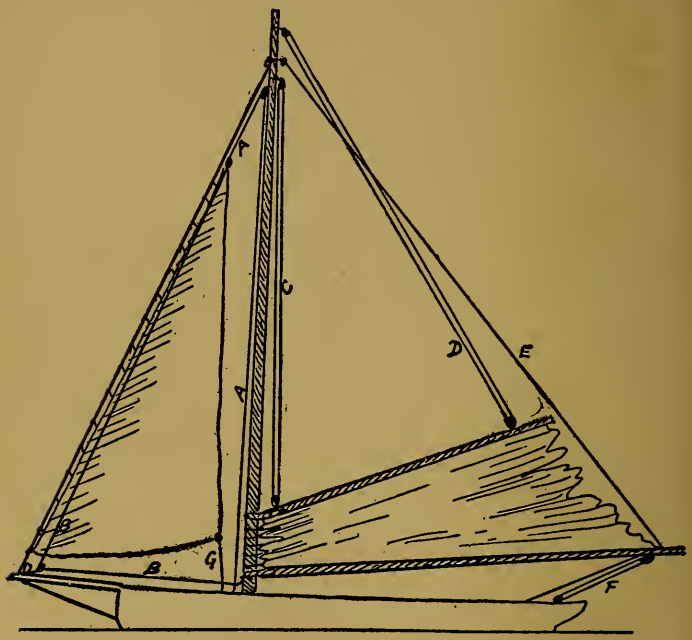
A great many people who have used boats or have traveled on them speak of a vessel's *rigging* without

knowing what the rigging really is. In the same way they speak of the "ropes" of a ship and while both terms may be correct in a way, yet to a sailor the terms would mean nothing definite. *Rigging* comprises all the ropes, sails, stays, halyards and in fact, everything above the decks which has anything to do with the sail plan or *rig* of a boat, but to sailors there are two definite types of rigging, even in the smallest craft. These are the standing rigging and the running rigging. The latter comprises only the various ropes, lines, etc., which move when the vessel is in use, while the *standing rigging* consists of all the permanent ropes, stays and other things which remain stationary. To enumerate the various individual parts of the standing and running rigging of a large vessel would require a great deal of space and would be of little value to the person who is interested only in small boats, but there are certain portions of the rigging which occur on every boat and which every boatman should know by heart.

As a matter of fact, there are very few "ropes" so-called, even on a full-rigged ship, for what appear as ropes to a landsman are known by specific names to sailors. Even on a small boat there are few ropes which are spoken of as such and nothing so loudly proclaims the landlubber as to speak of a *stay, halyard* or *sheet* as a "rope."

The *halyards* are the ropes which hoist the sails and they vary in number and name according to the type of sails used. As a rule there are two to each sail and known as the *throat halyards* and *peak halyards.*

(This refers only to fore-and-aft sails, see Chapter IV). The *throat halyard* being the one which hoists the edge of the sail nearest the mast, while the *peak*



RUNNING RIGGING OF FORE-AND-AFT RIG

A—Jib halyard. B—Downhaul. C—Throat halyard. D—Peak halyard. E—Topping lift. F—Main sheet. G—Jib sheet.

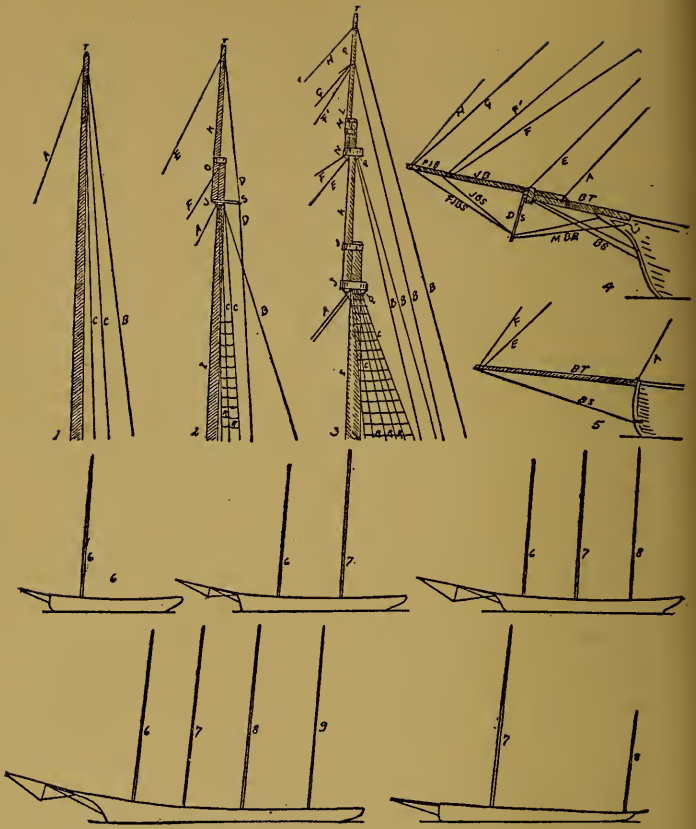
halyard raises the outer edge of the sail. Where sails have no gaff or piece of wood at the upper edge only one halyard is used.

The *sheet* is the line which is attached to the outer extremity of the sail and is controlled by the man sailing the boat and its purpose is to hold the sail in

any desired position and to enable the sailor to pull the sail in or to let it out, according to the direction of the wind and the course sailed.

Downhauls are ropes used in pulling down sails and are just the opposite of halyards and on small boats they are seldom necessary. *Topping lifts* are ropes which lead from the masthead to the end of boom to support the latter when the sail is lowered and they are usually so arranged that they may be hauled up or let down to raise or lower or *top* the boom. *Lazy jacks* are light lines extending from the mast head, or near it, to the boom and are used to prevent the sail from falling or bagging loose when lowered. They are seldom used on very small boats. *Brails* are ropes extending to the after edge of the sail by means of which the sail may be gathered close to the mast ready for furling.

All these are parts of the *running rigging* while the *standing rigging,* in its simplest form, consists of *stays* which are ropes or wires stretched from the top of the mast to the hull to keep the mast in position, or which extend from the top of the mast to the bowsprit and from the bowsprit to the stem to keep the bowsprit in its proper place. The stays from the mast to the bowsprit are known as *forestays* and upon them small sails are run up or down which are known as *jibs, forestaysails,* etc. (Chapter IV). Many boats which do not have bowsprits or jibs nevertheless have forestays running from the top of the mast to the bow, to keep the mast in one position, while many boats with bowsprits have stays running from the end of the



STANDING RIGGING, MASTS, ETC.

1—Polemast. 2—Mast with topmast. 3—Mast with topmast and topgallant mast. 4—Bowsprit with jib boom. 5—Pole bowsprit. 6—Foremast. 7—Mainmast. 8—Mizzen mast. 9—Jigger or spanker mast.

A—Forestay. B—Backstays. C—Shrouds or side stays. D—Topmast stay. E—Fore topmast stay. F—Jib stay. F′—Foretopgallant stay. G—Flying jib stay. H—Fore royal stay. I—Mast or lower mast. J—Trestle or cross trees. K—Top mast. L—Topgallant mast. M—Topmast cap. N—Topmast trestle or cross trees. O—Lowermast cap. P—Royal mast. Q—Futtock shrouds. R—Ratlines. S—Spreader.

BT—Bowsprit. JB—Jib boom. FJB—Flying jib boom. BS—Bobstays. DS—Martingale or dolphin striker. MBR—Martingale back ropes. JBS—Jib boom martingale stays. FJBS—Flying jib boom martingale stays.

bowsprit to the sides of the boat, their purpose being to keep the bowsprit from bending sideways.

On large vessels the stays are very numerous and there are *backstays* to keep the masts from bending forward, stays between the masts and many other kinds of stays, but most of these are never necessary on small boats. If the boat has a *topmast,* however, there are always *topmast-stays* and usually *backstays,* the former being spread apart, where the topmast and lowermast join, by means of a wooden or metal cross-piece known as a *spreader.* So also on boats with a long bowsprit, or where a second piece known as a *jib boom,* extends beyond the bowsprit, there are stays known as *bobstays* which are spread down toward the water by means of a metal or iron piece known as the *dolphin striker* or *martingale boom.*

In mentioning these various parts of the rigging I have used the terms "masts," "bowsprit," etc., and while I suppose that nearly every reader will know what a *mast* and a *bowsprit* is, yet it may be well to add a few words about them and their names. The *masts,* of course, are the sticks which carry the sails and rigging, and if there are more than one used, the forward mast is *always* the *foremast.* The one back of this is the *mainmast;* the third from the bow is the *mizzen,* while in four-masted vessels there is the *spanker mast* or *jigger mast.* Where the front mast is very high and there is another very small mast at the stern the latter is also known as the *jigger* or *mizzen* and the forward mast becomes the *mainmast.* Masts may be made in one or more sections according to the

rig of the vessel. If the mast is all in one piece it is known as a *polemast* and if another piece is placed above it this is known as the *topmast,* while in square-rigged vessels there are still other pieces known as *topgallant masts, royal masts,* etc.

The *bowsprit* is the stick which projects forward from the bow of a vessel and it may be either a *pole bowsprit* in one piece, or it may have a second piece attached to it and known as a *jib boom,* while on very large vessels there may be still a third part known as the *flying jib boom.* In addition to all these there are the various sticks or timbers which help spread the sails and which are known as *spars,* but as these vary in number and name according to the rig and sails used it is best to consider them in connection with the sails themselves.

CHAPTER IV

VARIOUS RIGS

Probably the first sail ever placed upon a boat was merely a piece of hide or skin, lashed to a sapling and kept spread open by a rough stick lashed across it. Through all the countless centuries this first form of sail has been retained and while the skin has been replaced by cloth and the rough saplings have given place to well-finished poles or spars, the spritsail, as it is called, still remains one of the simplest, handiest and most widely used of sails.

The true spritsail is a square, or nearly square, piece of canvas laced by one edge to the mast and kept stretched flat by means of a pole known as a *sprit* which extends from the lower part of the mast diagonally across the sail to the upper, outer corner.

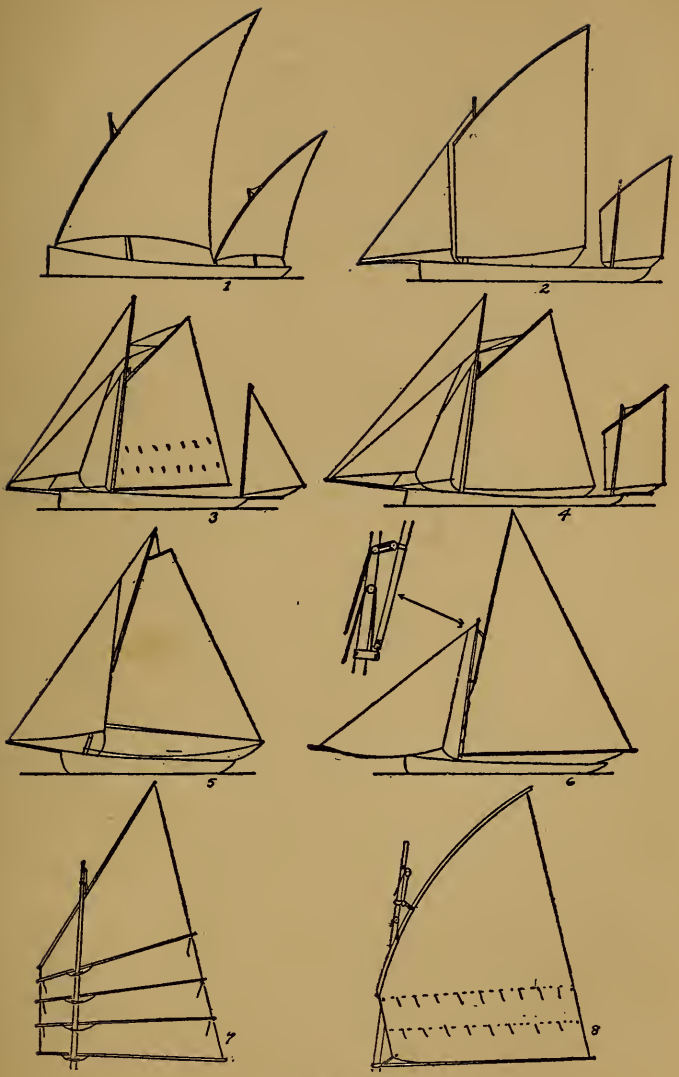
Sometimes the sail is attached to hoops or rings which run up and down the mast and a halyard is used in hoisting the sail but, in order to spread the sail well, the sprit must be pulled out by hand and cannot be arranged to rise or fall with the sail. The ordinary

method of securing the sprit is to place the tip in a small loop, or eye of rope made at the corner of the sail and then heave the sprit out until the sail is taut by means of a rope known as a *lanyard* which is attached to the mast and is passed through a hole or a notch in the lower end of the sprit.

Another very simple sail, which is really a modification of the spritsail, is the *leg-o'-mutton.* This differs mainly from the spritsail in form, for instead of being rectangular it is three-cornered and the sprit, instead of extending from the mast to the upper, outer corner of the sail, extends almost horizontally across it. Leg-o'-mutton sails, like the spritsails, are often arranged to be raised or lowered by a halyard and owing to the position of the sprit it is not necessary to remove it when lowering a leg-o'-mutton sail.

Some spritsails have two sprits, but this is a nuisance and for most purposes the leg-o'-mutton is the far better sail of the two. In the first place it stays flatter and thus enables one to sail closer to the wind; it does not have the tendency to "kick up" and wrap itself about the mast, like the spritsail, when sailing before the wind, and finally it is not so liable to capsize a boat in a heavy wind as the greatest area is low, whereas in the spritsail the upper portion presents the largest surface to the wind.

Somewhat similar to the leg-o'-mutton sail in form is the *gunter sail* or *sliding gunter,* which is a great favorite in many parts of Europe but which has never been widely introduced in America, although it has a great many advantages over other sails for small



VARIOUS RIGS

1—Felucca. 2—Lugger. 3—Nonpareil. 4—Dandy. 5—Bermuda boat. 6—French gunter. 7—Batten sail. 8—Settee sail.

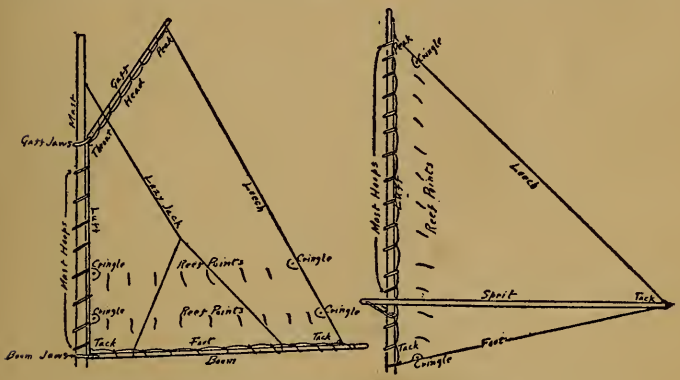
boats. The gunter sail is a very easy one to raise or lower, for there is no sprit to remove and it is very easy to reef. In the gunter sail the mast is made in two sections with the upper portion sliding by travellers over the lower portion, and to this movable part the single halyard is attached. In order to reef sail it is only necessary to lower the sliding mast a trifle, tie the reef points to the boom and again hoist the sail taut.

Another form of rig, which is seen everywhere in Oriental waters, and is the prime favorite with all Latin races, is the *lateen*. Like the leg-o'-mutton and the gunter rigs the lateen is triangular, but unlike the two former it is longer than high, or in other words, is placed horizontally, instead of perpendicularly. The lateen is a particularly good sail for small boats as the greatest area is low and why it has not been more generally adopted is something of a mystery. As used in the West Indies the lateen is rigged on a single, short mast which points or "rakes" slightly towards the bow of the boat. It has two yards and is raised and lowered by one halyard. It is kept taut and flat by a crotch, or ring, passed around the mast and fastened to the lower yard. Properly made the lateen will set very flat and smooth, it is easily and quickly raised or lowered, readily reefed and is the most graceful and picturesque of all rigs.

Somewhat like the lateen, but with the forward end cut off, is the *lugsail* which is the sail most often used by the fishermen of northern Europe and the British Isles. Personally I could never see any advantage

which this sail possesses over the common and much more simple spritsail or the ordinary boom-and-gaff sail and on large boats it is heavy, clumsy and far less to be recommended than several other forms.

The common *boom-and-gaff* sail is the one so familiar to everyone who lives on or near the water or who has ever seen sailing boats or vessels, for it is



PARTS OF SAILS, SPARS, ETC., OF FORE-AND-AFT RIG

more widely used than any other form and is the basis of all fore-and-aft rigs in most localities.

The true fore-and-aft sail or boom-and-gaff sail is really an adaptation of the older lugsail and is a vast improvement over it. It is attached to the mast by means of rings or travelers and has two spars; the one at the top known as the *gaff* and the one at the bottom known as the *boom*. There are two halyards used, known as the peak halyard and throat halyard; the latter being used to hoist the sail and the former to spread it tight and flat. This rig is noted for its

ability to sail close to the wind; it is easy to handle and in case of a sudden storm or squall the peak may be dropped and the area of the sail thus reduced without stopping to reef. For very small boats it has the disadvantage of requiring rather heavy spars and mast and a multiplicity of ropes, blocks, etc., and hence for this purpose the sprit, leg-o'-mutton, gunter or lateen rigs are preferable.

Aside from the shape or type of sails there are various rigs which are well recognized as standards and which are combinations of several sails. Thus the rig known as the *cat rig* is a single fore-and-aft sail near the bow of the boat. The *jib-and-mainsail* rig has a boom-and-gaff sail and a small triangular sail known as a *jib,* which is set on a stay running from the masthead to the bow, or to the end of the bowsprit. The *sloop* rig is like the jib-and-mainsail rig but in addition has a small sail known as a *topsail* between the gaff and the topmast it may also have two or three other small triangular sails on the forestays. When there are two of these the lowest is known as the *fore staysail,* the next is the *jib* and the third is the *flying jib. Schooners* are two-, three-, four-, five-, six- or even seven-masted vessels with the masts fore-and-aft rigged and with jibs like a sloop and with staysails between the various topmasts. In schooners the various fore-and-aft sails are all of nearly the same size with the sail on the rear mast the largest.

Two other rigs which have two masts and carry fore-and-aft sails are the *ketch* and the *yawl.* The ketch has a foremast rigged like that of a sloop, or schooner,

with a much smaller boom-and-gaff sail on a mast near the stern, while the *yawl* is practically the same with a still smaller rear sail. If the rear mast or mizzen is placed *in front of the sternpost* the rig is the *ketch* whereas if placed *behind the sternpost* it is a *yawl* rig. There are also *cat yawls* which have no jibs

1—Ketch Rig. 2—Cat Yawl Rig

and some ketches and yawls carry lugsails on both masts, or have a boom and gaff mainsail and a lugsail mizzen or even a sprit, lateen, leg-o'-mutton, gunter or other type of mizzen sail. Yawls and ketches are at times rigged with leg-o'-mutton, lug, gunter or lateen sails on both masts, but when thus rigged the crafts are not, properly speaking, either yawls or ketches. If lugsails are used the rig is really a *lugger;* if both masts carry leg-o'-mutton or gunter sails the

rig is known as the *nonpareil;* if the mizzen is a leg-o'mutton sail the boat is *dandy-rigged* and if both main and mizzen sails are of the lateen type the boat becomes a *felucca,* which is one of the favorite Mediterranean rigs and is familiar to every reader of sea tales as the typical rig of the Eastern corsairs.

All of the sails mentioned on these various rigs are those known as *working sails,* but in addition there are numerous light sails used when there is little wind or when racing, such as *spinnakers, jib topsails, balloon jibs,* etc., but which are of little interest in connection with small boats or boats for the amateur sailor. Nevertheless some knowledge of such matters never comes amiss and it is well to know the names and uses of these racing sails.

Spinnakers are immense triangular sails used when running before the wind and which are spread out from the side of the boat by means of a spar known as a spinnaker boom. *Balloon jibs* are huge, jib-like sails of very light cotton or silk used in place of the smaller head sails when running on, or before, the wind, while *jib topsails* are triangular sails run up on the stay which extends from the topmast to the bowsprit.

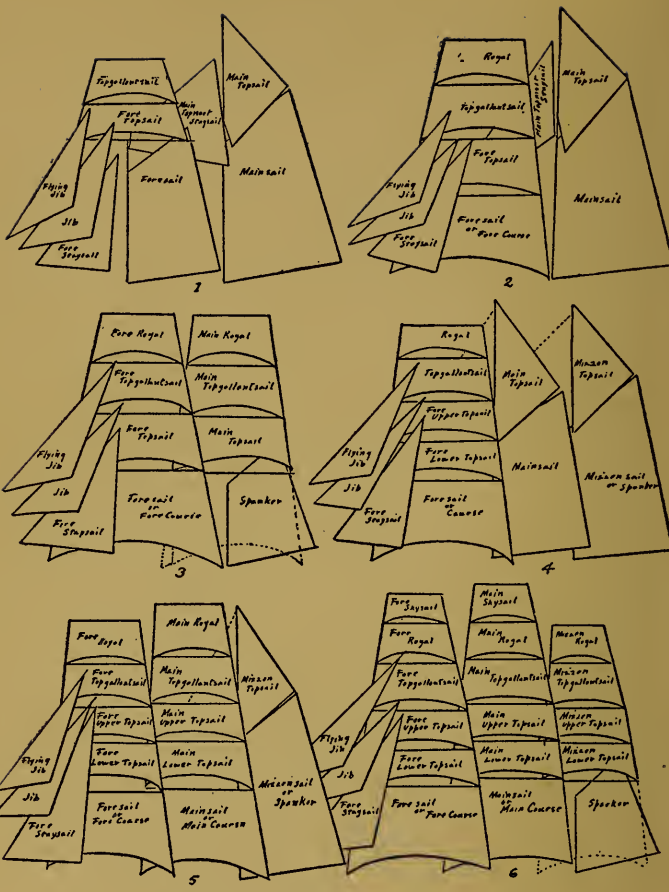
Nowadays fore-and-aft-rigged vessels form the bulk of all sailing craft, many of which are of immense size and capable of carrying many hundreds of tons of cargo. The use of fore-and-aft sails on any but small boats is comparatively recent, however, and formerly all large craft were what are known as *square-riggers.* Although far more beautiful and

stately than the schooners the square-rigged vessels gradually gave way to the more economical and handy fore-and-aft rigs and a few years ago one seldom saw a square-rigged vessel, save in out-of-the-way places. With the tremendous demand for ocean-going vessels, brought about by the European War, the square-riggers once more came into their own and today one may see ships, barks and brigs everywhere in the important ports of the world.

Although small boats are seldom square-rigged yet everyone who is fond of the sea and of boats should know something of square-rigged craft and should be familiar with the various rigs and their sails and should know the proper names and terms to use in speaking of them. To the landsman, and to many sailors as well, the rigging of a square-rigged vessel appears most complicated and confusing, but in reality it is very simple.

A great many people call every large vessel a "ship" and many more who can distinguish a sloop from a schooner, and a schooner from a yawl, fail to note the differences between the various square-rigs and call all square-rigged vessels "ships." As a matter of fact "ships" are only one type of square-rigged craft and it is just as erroneous to call a bark a "ship" as to call a sloop a "schooner."

Oddly enough one may trace the transition from the original square-riggers to the modern fore-and-aft schooners by the various rigs, for the old square sails died hard and even after the many advantages of fore-and-aft sails were proven sailors still held tenaciously



SAILS OF SQUARE-RIGGED VESSELS

1—Topsail schooner. 2—Brigantine. 3—Brig (main course in dotted lines). 4—Barkentine (with double topsails). 5—Bark (with double topsails). 6—Ship (with double topsails, fore and main skysails (mizzen course in dotted lines).

Staysails are omitted in Figs. 3, 4, 5, 6.

to certain square sails and thus many types of square-rigged vessels are combinations of the two forms and are really connecting links between true square-riggers and fore-and-aft rigs.

This is the case with the so-called "topsail schooners" which are almost a thing of the past in most countries but are still used in Newfoundland, the Canadian provinces and in parts of Europe. The topsail schooner is essentially a two-masted, fore-and-aft schooner, but the foretopmast is equipped with yards bearing square sails, the lower sail being known as the *foretopsail* and the upper one as the *foretopgallantsail.* Another step backward and we find the foremast equipped entirely with square sails, the fore-and-aft sail on the foremast missing and a fourth square sail above the foretopgallantsail. This rig is known as the *brigantine,* while in the rig known as a *brig* both masts carry square sails and in addition the mainmast is furnished with a fore-and-aft sail known as the *spanker.* In every square-rigged vessel there are a definite number of square sails on each mast and these always have the same name, although some vessels do not carry all of them. Thus, the lowest sail is the *course,* the next is the *topsail,* the next the *topgallantsail,* the next the *royal* and the highest of all is the *skysail.*

Formerly each of these sails was in one large piece, but in order to make it easier to handle them *double topsails* and *double topgallantsails* were invented and are now in general use. Thus one may see square-rigged vessels with *seven* instead of *five* square sails on

each mast, but the names remain the same, the second and third sails above the deck becoming *lower* and *upper topsails,* and the two above these being *lower* and *upper topgallantsails.* Many other vessels carry double topsails and single topgallantsails, but one can always recognize these *double* sails as they are much narrower than the full sails. Comparatively few vessels carry skysails, many do not even carry royals and still others carry more on one mast than on another.

Just as brigantines form a sort of connecting link between brigs and two-masted schooners so *barkentines* and *barks* are connecting links between three-masted schooners and real ships. The barkentine has the forward mast square-rigged with the main and mizzen masts fore-and-aft rigged, while the *bark* has the fore and mainmast square-rigged and only the mizzen fore-and-aft rigged. Finally there is the true *ship* or "full rigged ship," as it is often called, in which all three masts are square-rigged with a small fore-and-aft spanker on the last, or mizzen, mast.

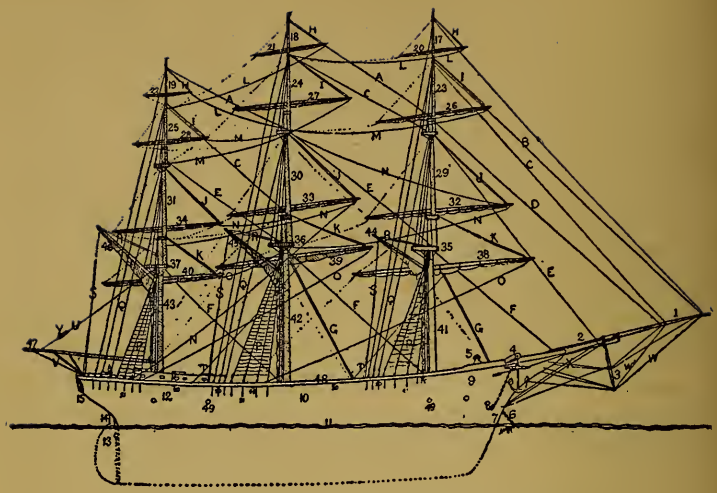
In former years barks and ships never had more than three masts, but with the advent of steel hulls, and donkey engines to hoist and trim sails, four-, five- and even six-masted barks and ships came into use. It is sometimes difficult to tell whether these vessels are barks or ships, but if there is *more than one mast fore-and-aft rigged* they are properly *barkentines,* if *only one* mast is *without square sails* the vessel is a bark and if square sails are on all masts it is a ship;—regardless of how many masts there are. Just as fore-

and-aft rigged vessels carry light sails to supplement the ordinary working sails, so square-rigged vessels often spread additional canvas when the winds are light or when greater speed is desired. Between the various masts *staysails,* shaped like jibs, are extended, while at times small sails known as *studding sails* or *stunsails* are set at the outer ends of the square sails. These light sails take the names of the masts or yards from which they are set and thus there are *main* and *mizzen topmast* and *topgallant staysails; fore, main* and *mizzen topgallant* and *royal studding sails,* etc.

These great steel and iron square-riggers often have each of their masts in one piece or *polemasts,* but the older and typical square-rigged vessels had their masts made up of several pieces, each of which carried a sail, and the names of each section corresponded to the sail which it carried. Thus the lowest section was the *mast* proper, the piece above was the *topmast,* the next was the *topgallant mast,* the next the *royal mast* and the slenderest, uppermost part was the *skysail pole.*

Each of these masts had its own stays and shrouds and between the masts triangular, jib-like sails known as *staysails* were set. These were named after the masts to which the *upper ends* were attached and thus the staysail which extended downward from the top of the *topgallant* mast was a *topgallant staysail,* etc.

It will thus be seen that in order to know the names of all the sails on a square-rigged vessel it is only necessary to learn the names of the five parts of each mast, for every sail has the same name with the addi-



HULL, SPARS AND RIGGING OF A SHIP

1—Jib boom. 2—Bowsprit. 3—Dolphin-striker or martingale. 4—Cathead. 5—Capstan. 6—Cable. 7—Stem or Cutwater. 8—Hawse-pipe or hawse-hole. 9—Starboard bow. 10—Starboard beam. 11—Waterline. 12—Starboard quarter. 13—Rudder. 14—Rudder post. 15—Counter. 16—Deck house or cuddy. 17—Fore royalmast. 18—Main royalmast. 19—Mizzen royalmast. 20—Fore royalyard. 21—Main royalyard. 22—Mizzen royalyard. 23—Fore topgallantmast. 24—Main topgallantmast. 25—Mizzen topgallantmast. 26—Fore topgallantyard. 27—Main topgallantyard. 28—Mizzen topgallantyard. 29—Fore topmast. 30—Main topmast. 31—Mizzen topmast. 32—Fore topsailyard. 33—Main topsailyard. 34—Mizzen topsailyard. 35—Foretop. 36—Maintop. 37—Mizzentop. 38—Foreyard. 39—Mainyard. 40—Mizzen, or Cross-jack, yard. 41—Foremast. 42—Mainmast. 43—Mizzenmast. 44—Foregaff, or fore-spencer-gaff. 45—Trysail-gaff, or Main-spencer-gaff. 46—Spanker-gaff. 47—Spanker-boom. 48—Bulwark, or rail. 49—Starboard ports. 50—Starboard scupper-holes. 51—Starboard chain-plates.

A, A, A—Fore, main and mizzen royal-stays. B—Flying-jib-stay. C, C, C—Fore, main and mizzen topgallant-stays. D—Jib-stay. E, E, E—Fore, main and mizzen topmast-stays. F, F, F—Fore, main and mizzen-stays. G, G—Fore and main-tacks. H, H, H—Fore, main and mizzen royal-lifts. I, I, I—Fore, main and mizzen topgallant-lifts. J, J, J—Fore, main and mizzen topsail-lifts. K, K, K—Fore, main and mizzen, or cross-jack, lifts. L, L, L—Fore, main and mizzen royal-braces. M, M, M—Fore, main and mizzen topgallant-braces.

tion of fore, main, or mizzen as the case may be. The same is true of the yards, the stays, the halyards and every other part of a ship's rigging and so the seemingly complicated maze becomes very simple, for all you have to do it to learn the names of the various parts on one mast and prefix *fore, main* or *mizzen* to them for those on the other masts.

Just as the little catboat has its stays, halyards and sheet, so the huge, towering ship has its stays and shrouds, sheets and halyards and the use of each is exactly the same as on the catboat with its single sail. The stays or shrouds always hold the masts in position and strengthen them. There are *backstays, forestays* and *bobstays* on every vessel, and each is designated by the proper prefix of *fore, main* or *mizzen, top, topgallant, royal,* etc.

The halyards are to hoist the sails and they take their names from the sails to which they are attached. The sheets are used to haul the sails flat and tight and they extend from the corners of the sails to the tips of the yards, but in addition there are many parts of

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HULL, SPARS AND RIGGING OF A SHIP (*continued*)

N, N, N—Fore, main and mizzen topsail-braces. O, O, O—Fore, main and mizzen, or cross-jack, braces. P, P, P—Fore, main and mizzen starboard shrouds. Q, Q, Q—Fore, main and mizzen backstays. R, R, R—Peak halyards. S, S, S—Trysail and spanker vangs. T, T—Fore and main sheets. U—Spanker topping-lift. V—Spanker sheet. W—Flying martingale. W'—Martingale stay. X—Bobstays. Y—Chafing gear.

NOTE—Modern vessels carry double-topsails and often double topgallantsails also, in which case the words "upper" or "lower" are prefixed to the sails, spars and rigging of these sails. Skysails also are carried at times. These are small sails set on the skysail poles above the royal masts and their rigging takes the prefix "skysail." Spencers and trysails are often omitted and are obsolete, as are studding sails.

the rigging which have no counterpart on fore-and-aft-rigged vessels. For example, the *braces* are used to swing or set the yards in various positions, the *clewlines* are used to gather up the sails ready for furling and there are *buntlines, garnet-lines* and many other *lines* which are only used on square-riggers and are of little interest, unless you expect to use a square rig or are interested in all things pertaining to sailing craft.

It may sound foolish to speak of using a square rig, but one can have a lot of fun and can learn a great deal about ships and sailing by fitting up a small boat as a brig, bark, or ship. I once had a twenty-foot sharpie rigged as a miniature full-rigged ship. Of course there is no practical advantage in this, for the square rigs require a great deal of care, they do not sail as well as fore-and-aft rigs when tacking to windward, and they should never be used, save as a means of recreation and for sailing on smooth waters, on a small boat.

As to which is the best fore-and-aft rig to use on small boats there is a great diversity of opinion, for every boat sailor has his own ideas and his own favorite rig and what may prove very satisfactory to one person may not be at all satisfactory to another.

The best method to follow in determining your rig is to weigh the advantages and disadvantages of each, adopt the one you think best suited to your special requirements and your boat and if this doesn't fulfill expectations try another. No two boats, even of the same model, sail just alike and often one rig will give

far better results on one type of boat than on another while the character of the waters sailed, the prevalent winds, the size of the boat, its form, the purpose for which it is used and many other factors must be considered when deciding upon a rig.

If you are a beginner and your boat is small and open, a leg-o'-mutton or gunter sail will probably be as good as any, whereas if your boat is very stable or heavy, or if you sail where there are light winds, a lug, sprit or boom-and-gaff sail will be better.

It is a great mistake to place too much sail on a boat for nothing is gained by it and the dangers of sailing are vastly increased. Too much sail on a boat will invariably and inevitably result in one of three things. If the boat is not wonderfully stable she will capsize, or will lean over until she swamps; if so heavy or stable that she still stands up, the wind will rip the sail or tear out the masts and if neither of these casualties occur she will simply "drag" sail and will handle badly. Every boat will sail to the very best advantage with a definite amount of sail and the amount will vary according to the breeze. Hence it is no economy to carry on with all sail in a heavy wind, for if the sail used is adapted to the boat for light winds it stands to reason it will be far too much in heavy weather.

Flat-bottomed boats are usually very safe if properly handled and not provided with too much sail, but owing to their shape they capsize very quickly once they are tipped a trifle too far. For this reason leg-o'-mutton or gunter sails should be selected for this

type of boat, partly because they offer a small area to the wind near their tops and because they have the quality of "spilling" the wind when at an angle and thus preventing the boat from being tipped dangerously. A flat-bottomed boat may be sailed in perfect safety with these sails when lug or boom-and-gaff sails of the same area would be extremely dangerous.

Another matter to remember is that a greater amount of sail may be safely carried as two or more sails than would be possible in a single sail, but for boats less than twenty feet over all a multiplicity of sails is a nuisance. The question of just how much sail should be carried is a very difficult one to answer, for boats vary in their stability and a great deal depends upon how they are handled and the skill of the sailor. For ordinary open boats used for pleasure where a single sail is carried, the sail area should not greatly exceed one and one-half times the number of square feet obtained by multiplying the boat's length by its extreme breadth. Thus a boat twenty feet long by five feet wide could safely carry one hundred and fifty square feet of canvas, but for safety this should be as low as possible. A sail fifteen feet high and seven feet wide might upset the boat before it would drive it along and yet a sail ten feet high and twelve feet wide might serve to sail the boat very well and without any danger of capsizing. At any rate, until you are thoroughly familiar with handling your boat and with the rudiments of sailing under all conditions, you should confine yourself to a small amount of sail and should make haste slowly.

In addition to the fore-and-aft sails described

there are many which are combinations, adaptations or improvements and which are known by different names. Among these are the *French gunter* in which the upper portion of the mast not only slides on the lower part but may be lowered like a gaff as well; the leg-o'-mutton with a boom at the lower edge in place of the sprit; the various *battened* sails which are really lugsails fitted with light wooden strips, or battens, across them to keep the sails flatter and to make reefing easier; the old-fashioned lugsails which have no spar or boom at the lower edge; the *settee* sails which have a boom and a much curved and very long upper yard like a *lateen,* and finally the *Bermuda* sails which are different from all.

The Bermudians consider a boat's ability to carry sail in heavy weather and to sail close to the wind of the greatest importance and their boats and sails are designed primarily for these objects. The true Bermuda sail is like a leg-o'-mutton with a curved lower edge and with the top point cut off and attached to a short piece of wood or *club* to which the halyard is fastened. In place of a boom there is a sprit-like pole which is provided with a small tackle on the mast end and the sail is set very flat by hauling out on this tackle, very much as in the leg-o'-mutton sail. The greatest peculiarity of the Bermuda rig is that the mast is set very far forward and leans or *rakes* sharply backward and a good-sized jib is carried. It is a splendid rig for windward work, but is a bad rig before the wind and for amateur use is not to be recommended.

For boats over twenty-five feet long nothing is

handier or better than the yawl rig. In the first place it is just as easy to sail as a sloop or jib-and-mainsail rig, for the tiny mizzen practically takes care of itself. When coming to a mooring or to anchor the mainsail may be lowered and the boat handled under jib and mizzen and by hauling the mizzen close in and lowering the other sails the boat will lie right in the wind's eye when at moorings or riding out a gale. If in a narrow channel a yawl may actually be *backed* out by swinging the mizzen across the boat and lowering the other sails and when tacking or coming about in a seaway or where there is a strong current the mizzen helps wonderfully and the boat's head may be quickly brought about by hauling the mizzen to windward. In case of a sudden squall or a heavy wind the boat may be sailed safely under jib and mizzen and, best of all, when one is obliged to reef, it is not necessary to anchor or toss about helplessly and drift down the wind, for the mainsail may be lowered and reefed in comfort while holding on the course under jib and mizzen.

Nevertheless the beginner should never attempt to learn to sail or handle a boat with a yawl, schooner, sloop or even a jib-and-mainsail rig. Commence with a single, simple sail, such as a sprit, a leg-o'-mutton, a gunter, a lug, a lateen or a gaff-and-boom sail and when you have become thoroughly accustomed to this, when you know how to sail and handle your simple boat and sail under all conditions, then and not until then, you may try your hand at craft with more sails and rigging.

CHAPTER V

HOW TO SAIL A SMALL BOAT

The first thing you should learn to do if you expect to use a boat, is to learn to swim. A sailboat, properly rigged, well built and intelligently handled, is as safe as a rowboat or a launch and is far safer than any canoe ever built, but under the best of conditions and even with experienced sailors, accidents will at times happen and then the fellow who can swim stands a far better chance than the chap who cannot.

Excellent swimmers are drowned it is true, but that's in spite of their knowledge, not because of it. Even if you are never upset, never have an accident and are never called upon to save yourself or others, yet the knowledge of how to swim will be mighty valuable. In the first place it will give you and your companions greater confidence, and confidence and self-reliance are big assets when sailing a boat, especially under trying conditions.

But because you *can* swim it doesn't follow that you should take to the water whenever an accident occurs.

A good sailor always sticks to his ship and you should *never* forsake your boat, no matter what condition she's in, until compelled to desert her by her actually sinking under you. A water-logged or capsized boat will float for hours or days and will support several persons and when clinging to an upset or wrecked boat you stand a much better chance of being seen and rescued than when swimming.

Many a man has been drowned by leaving his upset boat and attempting to swim ashore when, by clinging to the craft, he would have been saved. This was the case with two friends of the author. There were three in the boat, all splendid swimmers, and they were capsized in a sudden squall several miles from shore. The occupants easily clambered upon the overturned hull and gave little heed to their predicament, as they knew that several boats and steamers were due to pass the spot where they were shipwrecked within a few hours.

About half-a-mile distant a schooner, which was used as a temporary lightship, was anchored and finally one of the men suggested swimming to it. Feeling confident that he would have no difficulty in reaching the schooner he plunged overboard and swam rapidly away. Presently he turned and called to the others to follow and one of his companions did so, while the other wisely remained on the bottom of the boat.

When about halfway to the schooner the foremost of the two swimmers threw up his hands and went down and a few moments later the other sank, but the sensible one of the trio, who stuck to the boat.

was sighted and rescued by a passing craft an hour or two later and was none the worse for his experience.

No matter how well you can swim always remember that any solid object is far safer than the water and *don't* resort to swimming unless actually compelled to do so. *Always* bear in mind that it takes but a very little to support a person in the water—an old pail or bucket held perpendicularly and bottomside up, an open umbrella, an oar, a thwart, a spar, a grating or even a high hat or a derby will serve to keep a human being afloat for a long time.

Almost as important as the ability to swim is the ability to keep one's head and not get rattled under any and all conditions. The sailor should be able to move and act rapidly, surely and intelligently; he should possess decisiveness and judgment and should know just what to do and how to do it on the spur of the moment. When things go wrong is just the time for you to go right and many a trivial accident has become a tragedy through people losing their heads, tangling ropes or gear, jumping about heedlessly and forgetting just what to do under the circumstances.

In boat sailing of all things make haste slowly and NEVER TAKE CHANCES. You can't be overcautious in a boat and it is far wiser to run for shelter or to shorten sail too soon or in a moderate wind than to wait too long or to carry too much sail in a hard blow. Wherever sailboats are used for pleasure one may see foolhardy men and boys sailing under full canvas in reefing weather and trying to show off but

to the man who knows, such actions do not speak of skill or ability but merely of ignorance and bravado. Don't mind if such reckless fools laugh at your caution and think you are timid; the chances are that you'll be sailing about safely long after they are food for the fishes.

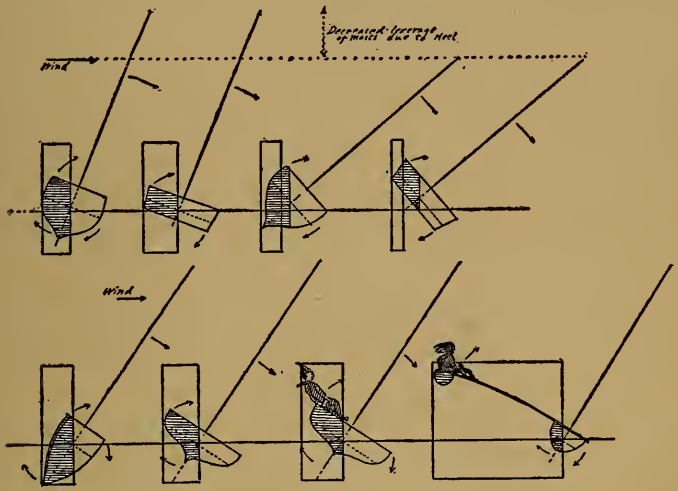
Before attempting to learn to sail it is well to know something of the principles of sailing and just why a boat under sail does certain things. Many landsmen cannot understand how a boat can sail *against* the wind or how it can sail with the wind abeam or blowing from the side without tipping over, but it's really a very simple matter and if you understand why and how these things are accomplished you'll be able to handle your boat far better than if you merely learn to do certain things without understanding the reasons for them.

Whenever the wind blows against a boat's sails it has two distinct effects; one tending to push the boat sideways and ahead, the other to push it over or upset it. The former tendency is desirable and must be encouraged whereas the latter must be overcome or resisted.

The resistance which a boat offers to the upsetting or "heeling" force is termed *stability* and the amount of stability which a boat possesses depends upon its model, its proportions, its weight and many other factors. Many boats have enough stability to overcome the tendency to upset without any artificial aid, but as a rule sufficient stability can only be obtained by adding some weight or *ballast* at the bottom of the boat.

This may take the form of lead or iron on the keel, a weighted centerboard, or lead, sandbags or other weights in the bottom of the hull.

When a boat is heeled over by the wind the sails act like a lever, with the fulcrum at the water line,



EFFECT OF WIND ON BOATS OF VARIOUS FORMS

Shaded portions indicate leverage of hull against sail. Outlined rectangles show relative stability areas.

while the hull below the water line represents the weight to be pried up. Of course you know that the longer the lever, beyond the fulcrum, as compared to the short end on the other side of the fulcrum, the greater is the power obtained.

Thus the farther a boat tips over the less force can the wind on the sails exert, for with every inch that the boat heels the length of the lever decreases, as will

be seen by the accompanying diagram. For this reason a boat tips much more easily when upright than after it has heeled over a bit and for the same reason a shallow or flat-bottomed boat tips more readily than a deep hull.

It would be perfectly feasible to build a boat so deep that it would not tip at all, and likewise a boat could be built so heavy, or with so much ballast, that the leverage of the sails would be unable to heel it in the least. But neither of these schemes would be practical. If the boat was built too deep it would offer so much resistance to the water that the sails could not drive it forward and if built too heavy or if it carried too much ballast, it would be slow, clumsy and the sails and masts might be carried away before the boat moved.

Moreover it is not desirable to prevent a boat from tipping to a certain extent. Many boats sail at their best while heeled at a sharp angle and the tendency to tip also serves as a sort of safety valve by spilling the wind from the sails and warning the sailor that too much sail is being carried and thus serving a very useful purpose. Hence, in order to make boats safely stable without making them heavy, slow or clumsy, various forms of hulls and various methods of ballasting are adopted.

For example, if a boat is made very broad and shallow the result, when tipped, will be almost the same as if the hull was made very deep and narrow but the resistance to the water will be overcome. As the hull is tipped up by the leverage of the masts the

upper side acts as a weight which must be lifted, and exerts just as great a counter-leverage as if the weight was under water. But instead of presenting a large surface with its attendant friction to the water the area of the boat's surface is reduced the more it is tipped.

Such broad, flat hulls are very stiff, up to a certain point, and boats built in this manner are usually very fast when heeling far over, but when they are tipped a single inch beyond a *certain* point the weight of the raised side acts *with* the lever and flops the boat over in an instant. When a hull thus shaped is provided with a centerboard or a weighted keel it becomes far more stable. Many of the fastest racing boats are of this type, a form designed to sail the very best when heeled far over with half the bottom out of water. To add to the stability under such conditions the bows and sterns are cut away for a long distance so that when sailing on a level keel the surface in contact with the water is very small, while the further they tip to one side or the other the greater the length is increased.

But in every case, whether stability is obtained by great breadth or *beam,* by extreme depth from deck to keel, by ballast inside or outside, by fin-keel or otherwise, you should remember that the *further under water the ballast is placed the less will be required.* Always bear in mind that ballast or weight on the downward or *lee* side aids the boat in tipping, whereas the same weight, on the upper side, prevents it and that the weight placed on the high side will exert

many times the force of the same weight in the center of the boat.

Often by sitting far out on the upper or *weather* edge of a boat, she may be sailed in safety through winds that would capsize her if you sat inside the cockpit. If a plank or board was extended out from the weather side and you perched upon that the boat would be still harder to upset and it is by such methods that the natives of the South Seas sail their catamarans and proas at terrific speed and with huge sails out of all proportion to the hulls. Sometimes one may see a "flying proa" tearing along in a perfect gale with half a dozen persons hanging on to the slender *outrigger* extending from the weather side, and by their weight alone preventing the queer craft from turning turtle.

All the above remarks refer to stability, but there is another factor which must be considered and which is known as *lateral resistance,* or in other words, the resistance offered to the water when moving sideways. A boat might be very stable and yet it might be worthless if it did not possess lateral resistance, for in that case it would merely slide sideways instead of going ahead and a properly designed boat must combine both stability and lateral resistance to the highest possible degree.

When sailing in any direction, save directly before the wind, there is a strong sideways pressure against the sails and unless the boat is provided with some means of overcoming this she will slip sideways or diagonally or will make "leeway," as a sailor would

say. Deep, narrow boats have great lateral resistance but their resistance to the water when moving forward is also great and hence the lateral resistance is usually obtained by means of deep, narrow keels, centerboard or leeboards. The knife-like keel offers little resistance to the water when moving forward but great resistance when moving sideways, while the centerboard may be pulled up entirely when moving forward with a wind from the rear, thus still further reducing the friction against the water.

If the boat possesses stability and lateral resistance and is properly rigged the wind blowing against the sails will have a tendency to force the stern of the craft away from the wind and the bow towards it. To overcome this the rudder must be turned until the pressure of the water against it has enough force to balance the action of the wind on the sails.

A properly rigged boat, if left to herself with rudder loose and sails set, will swing up into the wind of her own accord; in a few moments she will fall off, sail a short distance and again come into the wind and lose headway and will repeat this operation over and over again without danger of upsetting.

If, on the other hand, her sails are not adapted to her, if she is badly designed or improperly rigged, she will sail faster and faster, will fall more and more away from the wind and finally the sail will flop over to the other side and the boat will be upset or mast, sails and rigging will be carried away. Such a boat is a perfect deathtrap and should be avoided by all means.

Always try a new boat or a new rig to see how it will act if the helm is left when sails are set. If the boat comes up in the wind quickly of her own accord you may be sure she will come about readily when required and that she will take care of herself if at any time you are compelled to leave the tiller for a few moments. But don't condemn the boat if she falls off and sails away as I have described. As a rule this fault lies in the rig rather than in the boat itself and often a slight alteration in the shape or size of the sails or even the position of the mast will make all the difference between a safe and a dangerous boat.

If the sails are too far forward a boat may have a tendency to fall off and take a hard *lee helm,* whereas if too far aft the boat may have such a hard *weather helm* that it is impossible to prevent her from swinging up into the wind. Then again, the mast and sail may be in the right position and the sail may have its greatest area too far forward or too far aft, or the rudder may be too small. Try various adjustments before deciding the craft is hopeless and strive to have your boat so arranged that when sailing close-hauled a slight pressure must be exerted on the tiller to prevent her from coming into the wind or *luffing,* while just the instant this pressure is released she will swing up in the wind's eye with the sail fluttering and will hang there indefinitely, merely falling off, coming up again and remaining practically stationary in one place.

To a great many people it appears remarkable that a boat can sail against the wind ,but it is a very simple

matter indeed and depends upon the same principles which make a kite fly, an aeroplane rise or a windmill turn. In every case the result is brought about by the pressure of the wind upon a curved or angular surface and while the boat and windmill depend upon the wind to move them and the aeroplane produces the wind by moving rapidly through still air, yet the results in each case are identical and the object, unable to move away from the wind moves against it or at right angles to it.

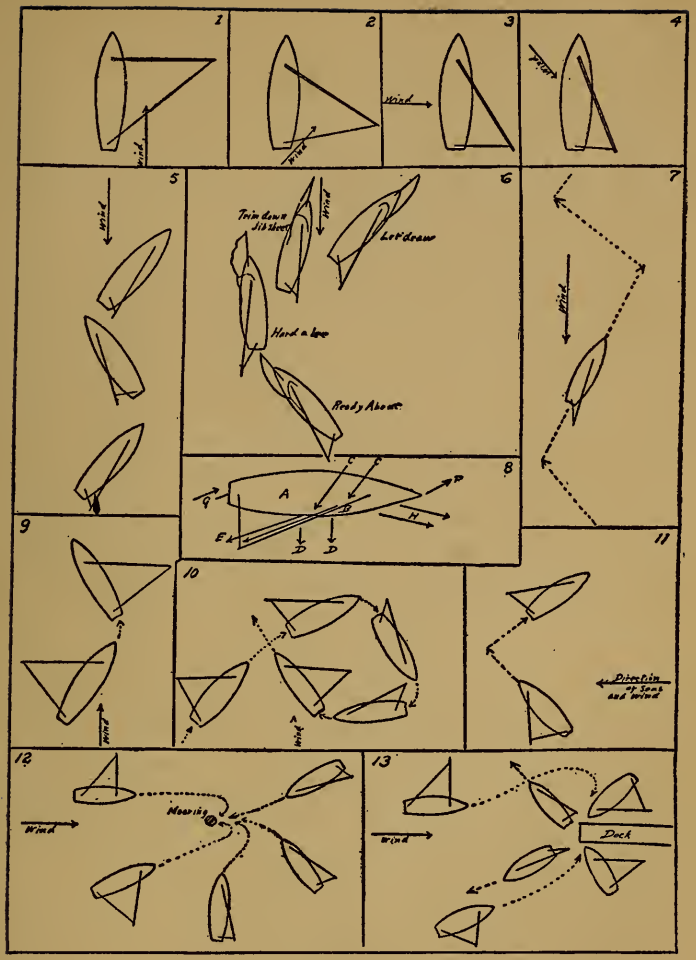
Whenever a moving mass of matter, such as air or water, strikes a curved surface two effects result, the first being to force the object aside, the other to force it ahead by what is known as "reaction." If a solid object, such as a bullet, strikes a slanting surface it glances off and frequently it loses very little of its force in doing so. The wind, when striking a curved surface, glances off and exerts its force at an angle.

The pressure of this glancing blow and the force exerted by the wind against the surrounding air as it slides off the sail, has a tendency to force the sail, or other surface, ahead. The direction in which the object is forced and the power required to move it depend upon the curve or angle which is presented to the wind.

The broader the angle at which the wind strikes, the less loss of force there is and the greater the power which the wind exerts upon the sail. Thus, when the wind is directly *against* the sail, very little power is wasted and the whole force drives the boat ahead as none of the wind can glance off. If the boat is

brought around until the wind blows from one side and the sail is pulled in until it is at an angle, the wind exerts a combined sideways and forward pressure and the boat sails at right angles to the wind; whereas if the sail is drawn still closer towards the center of the boat and the craft is headed nearer to the wind, the wind skips off the sail producing but little forward or sideways pressure but forcing the boat almost *against* the direction from which the wind blows. But if the boat is headed *too* close to the wind and the sail hauled in *too* near the center of the boat no headway will be made for the wind will then slip off the sail without exerting enough force to move the boat forward. If you will *always* bear these facts in mind you will find it far easier to learn to sail and you will also understand why you should *always* let your sail out as far as possible without letting it flutter or "spill" the wind.

Having thoroughly mastered these simple principles of why a boat sails you can safely start to learn how to handle your boat. If possible, have an experienced sailor go with you when learning; you will find his advice worth more than all the printed directions in the world, but even alone you'll have no trouble in learning to sail if you take plenty of time, master one thing thoroughly before trying another and use common sense and judgment. Before leaving shore or the anchorage be sure that everything is in the boat and in the proper place. There should be oars and oarlocks, a bailer, an anchor and plenty of line and all ropes should be neatly coiled where they are free to



SAILING

1—Before the wind or running free. 2—With wind on the quarter. 3—Beam wind or reaching. 4—Head wind or close hauled. 5—Tacking or beating to windward. 6—Going about with boat carrying a jib. 7—Making a long and short leg. 8—How a wind acts on a boat close hauled. 9—Jibing. 10—Wearing ship. 11—Tacking off the wind to avoid beam seas.

run out without becoming kinked, caught or tangled.

Make it a point *always* to keep the sheet clear and *never tie it or make it fast when sailing.* More accidents to sailboats have resulted from a tangled or fast sheet than from any other one cause.

When hoisting sail the sheet should be left slack enough to allow the sail to swing freely from side to side, but it should not be entirely free or the sail may swing out at right angles and strike some neighboring boat or obstruction, or it may even wrap itself about the mast and cause no end of trouble.

It is best to commence sailing "on the wind" or with the wind from one side or partly over the stern, for this is the easiest and safest kind of sailing. In this position most boats sail their best and obtain their greatest speed. If the wind is directly from one side the sail should be eased off until the forward edge commences to flutter, but if the wind is over the quarter the sail must be trimmed in order to be at as nearly a right angle to the wind as possible, as shown in the diagrams.

If, when sailing with a beam or quarter wind, you wish to turn about you should always haul in your sheet, push the tiller to leeward—away from the wind—and bring the boat up into the wind until the sail swings to the other side, when you may gradually ease-off the sheet until sailing as before.

If you attempt to turn about without doing this the sail will swing violently across from one side to the other, or in sailors' parlance, will *jibe* and while an experienced hand will jibe a boat with perfect safety

an amateur is very likely to capsize or to carry away masts and rigging.

It may seem at first as if sailing right before the wind would be the easiest thing to accomplish, but this is a great mistake. To sail before the wind, save in very light airs and with a small sail, requires a great deal of care and not a little skill.

A great many boats have a tendency to *yaw* or to swing wildly from side to side when thus sailing and when this is the case the sail is very likely to jibe with serious results. Even if this does not happen the sail may bag out and make the boat steer hard or the boom may "kick up" and become almost unmanageable. If allowed to swing out too far the boat may refuse to obey its helm and will swing around to the wind, regardless of your efforts to keep it on its course, while if kept in too closely the wind may catch it on the wrong side and jibe it suddenly.

In a heavy sea there is the added danger of the boom catching in a wave and "tripping" and either upsetting the boat or jibing as a result. If your boat yaws, if the boom kicks up badly, or if there is much of a wind, don't try to sail before the wind but sail partly side to it and go about every little while and thus zigzag towards your destination as shown in the sketch. If, while sailing before the wind or with a beam wind, you should desire to alter your course and bring the sail over the opposite side, *don't* turn *away* from the wind and jibe the sail, but haul in the sheet, turn into the wind and swing about in a circle until the sail is on the opposite side and you are headed

in the desired direction. This manner of turning about when sailing *free* or before the wind, is called *wearing ship* and to perform the evolution neatly and in a sailor-like manner will require some practice, for the sail must be hauled in and the helm put over at the same time and in perfect unison.

If the helm is put down too quickly the sail will flap and thrash and the boat may not come about, whereas if the sail is hauled in too rapidly and the helm is not thrown over promptly the boat may be tipped dangerously. Sometimes, however, it becomes necessary to jibe, while at other times a sudden shift of wind or some other cause may make a boat jibe despite every effort to prevent it.

When it becomes necessary to jibe, or if it is seen that it cannot be avoided, haul in the sheet just as rapidly as possible and just as soon as the boom passes the center of the boat pay out the sheet smoothly and quickly so that there will be no sudden jerk or pull as the wind swings the sail over. If there is much wind blowing it is a wise plan to lower the peak of the sail before jibing and when sailing before the wind dropping the peak will often make the boat sail better.

In sailing before the wind it is very important to have the boat ballasted or "trimmed" correctly. If there is too much weight near the bow the boat will invariably yaw and may bury her nose and swamp herself. On the other hand, if there is too much weight near the stern she may steer badly, but this is never as bad nor as dangerous as having her *down by the head*. If the boom has a tendency to jibe, to swing

badly or to kick up, it often helps a great deal to bring down the side over which the boom swings, by placing passengers, cargo or ballast on that side. If you are using a centerboard boat the board should be hauled up when before the wind and many boats will sail better with a beam or quarter wind when the board is half up, but the only way to determine when the board should be partly up, fully up, or down is to experiment. Some boats come about more quickly with the board up; others refuse to come round unless it is down, and some sail better with the board down, even when dead before the wind. When tacking or sailing on the wind the board should *always* be down, however.

As a rule a boat should be trimmed so that the stern is a little deeper than the bow and while the effect of a badly trimmed boat is more evident when sailing before the wind, yet in sailing on the wind a little fault in the proper distribution of weight may make a vast difference in the behavior of the boat.

When you have become thoroughly accustomed to handling your boat on the wind you may try tacking or sailing to windward or against the wind. As I have already explained no boat will sail *directly against* the wind, but by sailing as close to it as possible in one direction, then turning and sailing as close as you can in the opposite direction and repeating the operation at intervals progress may be made directly towards the wind.

This is known as "tacking" or "beating" and while it requires considerable skill and practice to beat to

windward to the best advantage yet it is not difficult to learn to tack and one can only become proficient by practice and by becoming thoroughly familiar with the boat.

Some boats will sail far closer to the wind than others and every boat has a certain point at which she will sail to windward to the best advantage. The nearer the boat is headed into the wind the closer or "flatter" the sail must be "trimmed" or hauled in and there is *always* a point at which the vessel loses headway and falls off the wind. For this reason it is a waste of time to try to sail too close to the wind and the objective point will be reached far quicker by heading off more and obtaining greater speed and making frequent tacks, than by attempting to head nearer the direction you desire to go and then losing almost as much as you gain by the boat's sliding to leeward.

The idea is to keep your boat pointed as near the wind as she will sail well and the sails should be trimmed in until quite flat each time you tack. Then, as the boat swings over on the other tack, the sail should be eased off a bit to obtain headway and the boat should be again headed towards the wind until the edge of the sail begins to flutter and wrinkle. This shows you are sailing as close to the wind as advisable and to sailors it is known as sailing *full and by*. Every few moments the boat may be brought a trifle closer to the wind and then eased off so that the sail is always filled and yet the edge, by its fluttering, shows the helmsman that the sheet is trimmed properly.

Some boats have a remarkable power of "eating

into" the wind in this way and although headed quite a bit off the wind will progress almost directly into the wind's eye. If the wind is quite stiff a great deal may also be gained by *luffing up* from time to time, or in other words bringing the boat directly into the wind, allowing her to shoot ahead for a short distance and before she loses headway bringing her off until she catches the wind again.

A great deal of the skill in tacking depends upon one's ability to judge just when to come about on the other tack. Very few boats will sail equally well on both tacks and as soon as you find on which tack your boat sails best you can make your longest tacks or "lays" on that tack and make shorter tacks when sailing with the wind on the other bow.

To make too many short tacks is a mistake for each time you go about you lose a trifle of what you have gained, but to make tacks which are too long is also a mistake, for you travel a great deal further than is necessary in this way. As a rule a *long and a short leg* is the best method to follow. This consists of making long tacks, or lays, close to the wind and then going about and making shorter and quicker reaches in the other direction a little farther off the wind. All of these maneuvers are illustrated in the diagrams and by studying these you will readily see just how the boat may be sailed directly to windward.

When ready to go about on a new tack the boat should always be eased off a little, the sails loosened lightly and as soon as the speed increases the rudder should be thrown hard over, the *tiller being pushed*

away from the wind. As the boat wheels about the sheet should be hauled in briskly until it begins to fill on the opposite side. Then ease it off gradually until good headway is made and trim in and head up to the wind as before.

When tacking with other persons in the boat you should always signal before going about or tacking by crying, *"Ready about"* and as the boat is brought into the wind, call, *"Hard-a-lee"* and at these words your passengers should duck their heads as the boom swings over or should shift their seats to the other side of the boat if she heels over very much.

Some boats have a tendency to remain hanging in the wind when brought about or else come into the wind and fall off on the same tack again. This is known as *missing stays* and when it occurs you should swing the boat's head around by an oar over the stern or hold the boom or sail far over to windward until the bow swings around. If the boat has a centerboard she may often be brought about quickly by raising the board as you swing her into the wind and then dropping it again as the sail fills away on the other tack.

If the boat carries a jib she will seldom miss stays if the jib is hauled flat as you go about and is kept sheeted to windward until the other sails fill away on the other tack. Then the windward sheet of the jib should be eased off and the leeward sheet should be trimmed in as shown in the illustration.

Usually a well built boat, if properly trimmed and rigged, will seldom miss stays except in heavy seas or in a very light wind or a strong current and often a

boat under reefed sails will come about more easily and will sail to windward far better than under full canvas.

Remember that a boat's sheets can be trimmed flatter in light winds and smooth waters than in rough seas and strong winds and that even a comparatively small sea will cause the sail to swing and spill the wind and thus lose headway.

Don't forget that when a boat, sailing close-hauled is to be turned so as to sail off the wind the sheets must be eased off as she swings about and in the same way a boat sailing free must have her sheets hauled in as you bring her up into the wind.

The foregoing directions apply to boats with one sail only and it is best to learn to sail with such a craft and then you will find it much easier to learn to handle a boat with headsails or jibs.

Many small boats have the jib sheet attached to a sliding block or ring which can move from side to side on a traveler and when thus arranged the jib requires little or no attention when tacking.

As a rule, however, the jib has two sheets, one on either side, which lead aft and in tacking these require attention. As the boat is turned into the wind the lee sheet is let go, the jib flutters and the instant the mainsail begins to fill on the other tack the jib sheet should be trimmed flat as before, and then, as the boat pays off on the new tack the sheets may be trimmed to obtain the best results.

One advantage of a jib is that in case the boat misses stays, or fails to come about readily, her head

may be brought around by keeping the lee jib sheet trimmed until the boat swings around and if the main boom is held far towards the lee side at the same time the boat will be almost certain to pay off.

If for any reason she refuses and commences to move backwards don't forget that the tiller *must be turned in the same direction as that in which you wish the head of the boat to go,* or in other words, in exactly the opposite direction to that in which you would turn it if moving ahead.

If a boat misses stays in heavy wind or squalls, ease off the main sheet, lower the peak a little and trim the jib to the windward. Then if the boat does not gather headway but heels, lower the mainsail at once. When sailing on the wind with a jib and mainsail, trim the lee jib sheet to get the full benefit of the sail and if running before the wind either lower the jib or "wing it out" on the opposite side to the mainsail by means of a light sprit, a boat-hook or an oar, so it will catch the wind.

When you are thoroughly familiar with sailing before the wind, on the wind and against the wind in light breezes and smooth water, you should practice coming to a mooring or a landing. The ability to make a good landing marks a good sailor and nothing looks worse or bespeaks poorer seamanship than to make a clumsy landing.

Never attempt to make a landing or a mooring until you have learned just how far your boat will luff or "shoot" ahead when brought into the wind. By trying a number of times you can soon determine this

and a mighty good plan is to practice luffing up to a stake or a float in the water.

When approaching a mooring or landing try to approach it from the leeward side; sail as nearly into the wind as possible and when you are near enough so that you think the boat will shoot to the mooring by her own momentum, bring her right into the wind's eye and ease off the sheet so that the sail flutters and then steer the boat as close to the mooring as you can.

Never attempt to shoot the boat to the windward side of a mooring or landing if it can be avoided, but come up with the mooring or landing *on your windward side.*

If conditions are such that you cannot approach the mooring or landing from the lee side and you are *compelled* to run for it before the wind or with a beam wind, there are two methods which may be followed. One is to lower sail and let the boat run to the mooring under bare poles and the other is to ease off the sheet until the sail offers no surface to the wind. When coming *before* the wind the former method is the only right one and in order not to approach too rapidly it is a good plan to drop most of the sail long before the landing is reached and leave just the upper portion raised so as to catch the wind and carry the boat along very slowly. Then, when close to the mooring, drop this and drift slowly to the spot where you are to make fast.

If you are using a boat with a jib that sail should be lowered as you approach your moorings and you should come to the place under mainsail alone, as a jib

as always in the way when going forward to make fast, and, moreover, it will frequently catch a puff of wind and force the head of the boat off at just the wrong instant.

If you are coming up to a dock or wharf don't run to it head-on if it can be avoided, but run slanting towards it or alongside, for in that case if your boat has too much headway it will merely strike the dock a glancing blow and do little, if any, damage, whereas the same blow head-on might start a plank or timber or cause other serious damage.

These remarks apply to fairly good sized sailboats and if you are sailing in a very small open boat it is often easier to take in sail and row to a mooring than to sail to it.

When getting away from a mooring or dock some skill and practice are required, especially if in waters where there are numerous other boats. If you are on the lee side of a dock it is very easy to hoist sail, trim the sheets flat, shove off the bow and start away; but if on the windward side and you hoist sail the wind will force your craft against the dock and make getting under way very difficult. At such times the best plan is to row or pole your boat out from the dock before hoisting sail and then get under way in open water.

If at a mooring or an anchorage the boat's head may be swung off the wind by hauling in the anchor from the *lee* side or by holding the sail far over to windward, but in every case you should look about, decide on your course and make a mental note of the

position of neighboring craft before getting away from your moorings.

When coming to an anchorage have the anchor ready to drop and the anchor line coiled so it will run out readily. When you reach the spot selected, luff up, allow the boat to lose her headway and then drop your anchor by *casting* it *ahead* of the boat.

If you cast your anchor out while the boat is still moving ahead your boat will overrun it and it may not get a good hold on the bottom, to say nothing of the danger of getting the line entangled with the flukes. If coming to an anchorage *before* the wind, drop the sails, and wait until the boat loses headway and if *on the wind* either lower sails or let the sheet flow.

Never, under any circumstances, allow the sheet to run out entirely for there is never any necessity of allowing the sail to swing out beyond right angles to the boat. If it swings farther it becomes a source of danger.

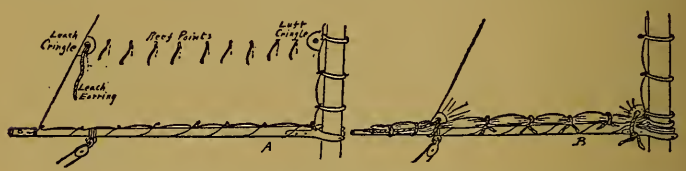
Never walk along the lee side of the boat when the sheet is loose and the sail is swinging, but move on the windward side and avoid any danger of being knocked overboard by the swinging boom and flapping sail.

When you have learned to sail in all directions in smooth weather and have learned how to get under way and how to come to moorings you should put in some time learning how to reef quickly.

Reefing consists in shortening sail by tying a portion of it to the mast or spar and small ropes known

as *reef points* are sewed into the sail for this purpose. Some boats have sails with only one set of reef points; others have two, and others have three or more, but when a sail is reefed the reefs should be taken one at a time beginning with the one nearest the mast or spar.

At the end of the row of *reef points* near the free edge of the sail there is a hole or eyelet known as a *cringle* and as this is on the *leech* of the sail it is called the *leech cringle.* A similar cringle is on the op-



REEFING A SAIL

A—Sail before reefing. B—Sail after reefing.

posite edge or *luff* of the sail. This applies to boom-and-gaff, lug or other sails with a boom or spar at the lower edge. Through these cringles lines known as *earrings* are passed and these may be left in the cringles permanently or they may be taken out when not in use, as you prefer.

To reef the sail bring the boat into the wind, trim the sheet in until the boom cannot swing beyond the sides of the boat, lower the sail about halfway and then lash the first luff cringle to the boom with the earring, tying it in a reefing knot which can be readily cast off. Then pass the luff earring through its cringle, pass it through the hole in the boom made for

that purpose and haul the sail out as taut as possible and make the earring fast.

Then beginning at the luff cringle, roll the sail neatly to the first reef points and tie each reef point in turn around the bottom of the sail where it is fastened to the boom or, if there is no space to pass the points between sail and boom, tie them around the boom, being very careful to use square or reef knots when doing so.

When all the points are tied hoist away the sail and you are ready to proceed. If a second reef is required repeat the operation with the second row of points and cringles. Then, when the wind lulls, one reef after another can be shaken out by untying the reef points, casting off the leech earring and then casting off the luff earring and hoisting the sail until taut.

Don't wait too long before reefing. If the boat heels badly on the wind, if it labors, if it takes a hard helm or if the wind is puffy, squally or strong, reef at once. It's far easier to shake out your reefs if the wind falls than it is to take in a reef when the wind is blowing hard and a heavy sea is running.

Finally, when you come to your moorings, to your landing-place or to an anchorage, never leave your boat with the sails loose, slovenly and unfurled. In the first place it looks badly and stamps you as a poor sailor; in the second place it soon ruins the sail and finally, if a hard wind comes up, the sail is liable to become loose, to catch the wind and either tear the sail to pieces or capsize the boat.

Make it an invariable rule to do things in a regular

routine every time you come to a mooring or leave it. As soon as you are fast to your mooring lower the sails, trim the boom amidships, roll the sail neatly and tie it to the boom by short pieces of line or by one long rope wrapped around and around it. *Don't* commence furling the sail at the outer end of the boom, but place the first line or "stop" close to the mast and keep pulling out the excess slack as you work outwards along the boom and you will soon find it a very simple, easy thing to furl your sails very neatly.

When all is snugly furled, hoist away until the sail is lifted slightly and either place a *crotch* under it, lower it and draw the sheet taut, or else fasten a rope from the boom to both sides of the boat so the sail cannot swing as the boat sways and rolls to the waves.

It is a good plan to have a sail cover of waterproof cloth or heavy canvas with which to cover the furled sail and by using this your sails will always be protected from rain and mildew and will remain strong, white and in good shape.

Finally, see that everything about the boat is in its place, that all lines and ropes are neatly coiled and that nothing is left to swing, rattle or work loose; that the centerboard, if the boat has one, is pulled up in its case and secured; that the tiller is lashed amidships, or is slipped out of the rudder head and that everything is snug and shipshape.

CHAPTER VI

THE CARE OF BOATS

Every boat, no matter how small, requires a certain amount of care and attention and this is a matter which is all too often neglected.

The larger the boat the more care it will require, while boats in salt water need far more attention than those in fresh water.

If a boat is pulled up on shore, or is placed in a boathouse when not in use, it will require less care than a craft kept in the water at an anchorage or moorings, but even when thus hauled out there are a certain number of things which must be attended to.

Boats in the water are subject to the action of the water, the depredations of marine animals, the growth of marine plants and to the dangers from storms. Unless these are guarded against and overcome a boat will soon be worthless. In fresh water the effect of the water upon wood and metal is far less injurious than in salt water and the troubles from animal life and water plants are almost negligible. When in salt

water these things are among the most important matters to be guarded against and constant care and watchfulness are necessary if a boat is to be kept in good condition.

Salt water corrodes and rusts iron very rapidly and hence boats with plain iron fastenings and fittings should be avoided for salt water use. Copper or brass fastenings and brass or bronze fittings are far better, but these are expensive. Galvanized iron is therefore adopted very generally for salt water use on boats.

Even when a boat is well painted and the iron parts are thus protected, the salt water will corrode and destroy the iron work and just as soon as the paint becomes old, thin, worn or chipped off, the parts go to pieces very rapidly. For this reason boats should always be kept well painted and varnished at all times, and whenever a bit of paint is rubbed or knocked off, it should immediately be touched up with fresh paint.

In salt water, too, marine animals and seaweeds attach themselves to every submerged portion of a boat's hull and grow very rapidly.

Not only do these growths hinder a boat from sailing well and rapidly, but they also destroy the paint and injure the wood beneath it. This paves the way for the water to soak into the planks and timbers and rot them and corrode the metal fastenings which hold the various parts of the boat together.

Still more injurious are the shipworms or *teredos*. These are marine animals which are not really worms at all, but are a species of mollusc related to the common clam. They do not *eat* the wood, as many people

think, but merely bore into it to form their homes or burrows, and wherever they go they line their holes with a thin coating of lime or shell.

The shipworms are very small when they first enter the wood and as they increase in size they bore larger and larger holes until they riddle the wood with burrows and completely destroy it. No signs, however, save a few tiny holes, may be visible externally. So rapidly do they work if unchecked that large ships have been sunk by them in less than a year and there are several records of such catastrophes occurring.

Teredos seldom attack wood which is far below the surface but work mostly at or near the water line. For that reason small boats of shallow draft are often more seriously and rapidly injured by these pests than larger and deeper boats.

Moreover the shipworms seek spots which are out of sight for their depredations and unless the boat-owner is very careful he may overlook very serious injuries by the teredos without dreaming that they exist. The cracks between keels and sternposts, between keels and garboard planks and the interior or centerboard trunks and cases are favorite spots for teredos to bore and quite often the timbers in such situations are completely destroyed and the boat is rendered worthless before one realizes that teredos have attacked the boat at all.

But even without marine growths and teredos the planks and timbers of a boat may become rotten and useless through the action of the water. This is particularly the case where a boat rests upon a muddy

bottom at low tide, for the mud contains gases and chemicals which destroy the paint and this allows the water to penetrate and rot the wood.

To guard against these three principal dangers every boat should be hauled out at frequent intervals, the bottom should be scrubbed, scraped and cleaned, and should then be allowed to dry thoroughly, after which it should be freshly painted with some reliable and good anti-fouling bottom paint such as the various copper paints. Large boats are usually sheathed or covered with copper plates below the water line in order to protect the wood, but small boats depend upon a coating of copper paint.

Whenever a boat is hauled out to be scraped and painted it should be examined carefully for rot or worms and the various planks, the keel, stem, stern-post, centerboard, centerboard trunk and case and in fact, all the woodwork below water should be tested for teredos or rot by probing with the tip of a knife blade. If the wood is sound the blade will not penetrate readily, whereas if the wood has been injured by worms or is rotten the blade will enter very easily. When this occurs a thorough investigation should be made to determine the extent of the damage.

If the spot is small it may be dug out by a chisel or gouge and the cavity may be filled with white lead or marine glue and painted over, whereas if there is a large area damaged a new plank or a new piece of timber must be fitted. In any case every hole, crack or crevice should be carefully plugged with white lead or marine glue before painting, for if this is not done

rot and worms will be almost certain to find the unprotected spots and will commence to destroy the wood.

If there is a stream or body of fresh water near at hand a great deal of time and trouble may be avoided by running your boat into fresh water and allowing her to remain there for a day or two at a time. Marine growths and teredos cannot live in fresh water and any which have become attached to the boat will die and drop off when the craft is left for a short time in fresh water. To be efficacious the water must be really fresh and *not* brackish, for many marine plants and animals *will* live and thrive in brackish water.

When boats are first placed in the water they are dry and often leak badly, but as the wood swells with the action of the water the seams tighten up and often a boat which leaks like a sieve when first launched will be perfectly tight after a few days' immersion. For this reason you should not be discouraged if your boat leaks when you first put her in the water, but if she still leaks after two or three days you may be sure there is something wrong which should be attended to at once. By bailing out the water and wiping the inside dry with a sponge you can usually find the leak, and if it is small it may be stopped by pushing caulking cotton into the seam or crack with a thin knife blade or a putty knife. Very often a small leak may be caused by a nail hole and this may be stopped completely by driving in a tiny wooden plug.

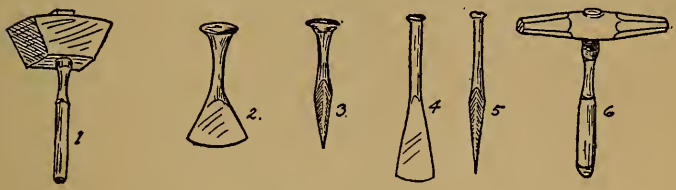
If there is difficulty in locating the leak from inside the boat, if the leak is large or if there are several,

the boat should be hauled out on shore and partly filled with water. Then, by watching the outside of the hull, you can easily find where the water runs out. The spots should then be marked, the water drawn out by means of the boat plug (a wooden plug driven into a hole through the planks near the keel), and the seams where the leaks occur should be cleaned free of all putty, paint and old caulking and should be re-caulked.

It is an easy matter to caulk a seam if a little care is used, the only implements and tools required being a small caulking iron, some caulking cotton and a hammer. Unravel a strand of the cotton, roll it between your palms until it forms a strand a trifle larger than the width of the crack to be caulked and then press the end into the seam with a corner of the caulking iron or a knife blade. Catch the strand of cotton lightly into the seam in this way all along the seam and then with the caulking iron and hammer drive the cotton well into the opening. It is impossible to describe just how to use the iron, but it is a knack soon acquired and is accomplished by a sort of rocking motion with the iron as the tool is struck lightly with the hammer.

Drive the cotton well below the surface of the wood but *don't* try to force in too much and *don't* drive it in so hard that it spreads or starts the plank. When the seams are well filled with cotton press white lead or marine glue over the caulking and paint thoroughly. *Never* use putty on a boat, especially below the water-line, for it will crumble and fall out very soon and

is no better than nothing at all. Use pure, thick white lead and linseed oil or the best marine glue. The white lead may be pressed in with a putty knife but



CAULKING TOOLS

1—Caulking mallet. 2, 3, 4, 5—Caulking irons. 6—Caulking hammer.

marine glue must be run in by means of a hot iron; full directions accompany the glue when purchased.

Before launching your boat in the spring all the seams should be cleaned free of old paint and lead, and if any of the old caulking is loose or hanging out it should be removed and replaced with new and all seams, rough spots and nail head holes should then be filled with white lead or marine glue before painting.

Don't drive the caulking too tightly into the seams when the boat is dry and *don't* fill the seams flush with the glue or lead. Leave a little hollow along every seam as otherwise, when the boat swells in the water, the caulking and filling will be forced out and will either flake off or will present rough, irregular surfaces to the water and will thus take a great deal from the speed of the boat.

It is a good plan to pour a quantity of water into

the boat a few days before launching as this will swell the planks and if any leaks exist you can find them before placing the boat overboard.

Before painting any part of the boat, all the old, loose, dry or rough paint should be scraped and sandpapered smooth and if it is in very bad shape it should be burned off by a torch, or removed by some good paint- and varnish-remover until the smooth surface of the wood is exposed.

Use only the very best paint and varnish for the boat, for cheap, poor paints and varnishes are worse than nothing on a boat, and the very best is the cheapest in the end. Use very little turpentine and still less dryer in the paint, for while paint mixed with oil alone may dry slowly, it will last far longer than paint with a great deal of turpentine or dryer. Haste makes waste in everything connected with a boat.

Aside from the care of the hull there are the masts, sails and rigging to be looked after. The masts and spars should be scraped and sandpapered, varnished with two coats of the best spar-varnish and allowed to dry thoroughly.

Standing rigging should be overhauled. Any frayed or worn parts should be renewed, the metal parts should be cleaned free of rust or corrosion and painted and new running rigging should be rove through the blocks if the old ropes are frayed, rotten, worn or weak. The blocks should all be looked over; broken ones should be replaced and sheaves should be oiled and turned until they move easily on their bearings.

The sails should be spread out; all torn or frayed spots mended and if reef points, earrings or other ropes on the sails are ravelled, frayed or worn, they should be replaced.

If the sails are mildewed, dirty or discolored, they should be scrubbed with good soap and water and bleached in the sun. Finally all stays and other rigging should be tightened up.

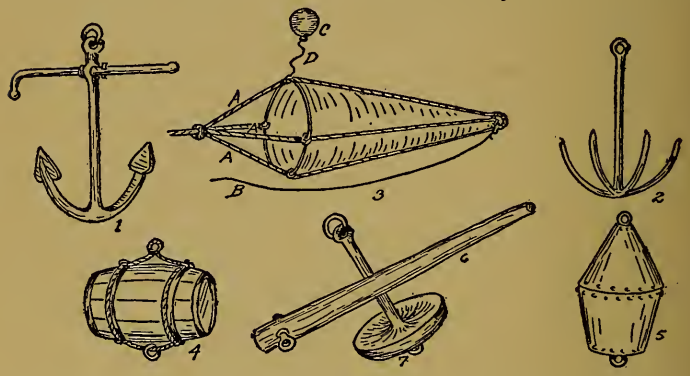
The boat's equipment should also be overhauled and put in first-class shape. A good time to attend to this is while the paint and varnish are drying.

Every boat, no matter how small, should *always* have an anchor on board with enough anchor line to allow you to anchor in fairly deep water—usually from fifty to one hundred feet of line according to the size of the boat and the depth of the waters where you sail. If the boat is small and a long anchor line is in the way the anchor may be attached to a comparatively short line and another line may be coiled and tied neatly and stored away where it can readily be reached if needed.

There are many kinds of anchors, but the commonest form is the ordinary two-fluke pattern with a sliding "stock." When not in use the cross-piece, or stock, is folded along the shank and thus occupies little space and when it is to be used the stock is held in position at right angles to the shank by a metal key. It is a good plan to seize the stock in position with a bit of line as well as by means of the key for the latter often works loose and allows the anchor to drag. There are also several good designs of folding anchors

and for very small boats grapnels may be used if desired.

There is no use in carrying an anchor unless it is large enough to hold the boat in a reasonable wind and sea and for small boats the anchors should weigh at least two pounds for every foot of the boat's water line length. Every boat over twenty-five feet in



ANCHORS

1—Common anchor. 2—Grapnel. 3—Drogue or sea-anchor. 4—Keg mooring buoy. 5—Iron mooring buoy. 6—Spar mooring buoy. 7—Mushroom anchor.

length should have at least two anchors, and one of these should be at least one-and-one-half times as heavy as the other. In addition to these real anchors there should be a *sea-anchor* or *drogue* in the boat if you ever expect to sail in any but the smoothest waters and lightest winds.

A drogue or sea-anchor consists of an iron ring or a strong wooden hoop from one to two feet in diameter which is often hinged or jointed so it may be folded up, and to this a conical canvas bag is sewn.

If the drogue is to be used on a fairly large boat it should be strengthened by ropes, as shown in the illustration, and in any case the ring or hoop should be provided with a four-rope "bridle" as illustrated (*A*). To the small end a light line (*B*) should be fastened to "trip" the drogue when you wish to draw it in, and a cork float (*C*) is attached at the end of a line three or four feet in length (*D*) to prevent the sea-anchor from sinking or "diving." Some people prefer a drogue with the lower or smaller end left open, but the form shown will serve for all-around purposes as well as any.

The drogue is used when "riding-out" a gale or "lying-to" in a storm or heavy sea and its purpose is to hold the boat's bow to the wind and waves and also to prevent the boat from drifting too rapidly to leeward. It should be attached to a stout line twenty-five to forty feet in length and passed over the bows and if there is no sea-anchor at hand a bucket, a couple of oars lashed crosswise, thwarts, spare sails, cushions, or, in fact, anything which will float and will offer a considerable resistance to the water, may be used in place of a drogue.

Not only will a drogue hold a boat's head on to wind and sea but it will also form a "smooth" for the boat and will often prevent the waves from breaking over the bow.

When riding to a drogue a close-reefed sail, or the upper part of the sail may be set to keep the boat steady if necessary, but most boats will ride very well to a drogue without any sail whatever.

Be sure that your boat has oars, oarlocks, a boat-hook, a compass and a lantern on board, for these simple things may save your life and they will come in useful scores of times. If you go on long cruises or sail any distance from shore you should also have a keg of fresh water in the boat at all times, for one never knows when an accident may happen and the boat may be kept out to sea for many hours at a time and if such an event *does* occur you will give heart-felt thanks for your foresight in providing drinking-water.

Finally there is the ballast. If the boat carries inside ballast it may be in the form of iron or lead bars, cobble stones or sandbags and these should be looked over, cleaned and put in good shape. If the sandbags leak, mend them with strong thread and give them a good coat of paint; if stones are used wash them in fresh water and let them dry before placing in the boat, and if iron bars are used, chip off the rust and give them a coat of asphaltum varnish, or some good metal paint.

When pulling up the boat for the winter or placing her "out of commission" *always* drain all the water out of the hull. All weeds, shells and marine growths should be removed from the bottom and the planks should be scrubbed off and the keel blocked up so that it rests on a firm support at several points, as otherwise it may bend or buckle from the boat's weight.

The inside ballast should be taken out and placed aside; the running rigging should be taken down, coiled and hung in a safe dry spot; all the equipment

should be taken from the boat and stored away and the sails should be soaked in fresh water, dried thoroughly, rolled up and stored in a dry loft or similar place.

A little care and trouble taken in such matters will save a vast amount of time, trouble and expense when ready to put the boat in the water, for dampness, dirt and rust will play havoc with the woodwork, ropes, sails and other parts of the boat if left alone over winter, while marine growths and old paint are far easier to remove from the bottom when wet and fresh than after they have dried and hardened during the months in which the boat is hauled out.

If you use a mooring this should be taken up in the fall and stored over winter, for ice will often carry away a mooring buoy and chain which will resist the most severe storms. If the stone, anchor or other object used as a mooring is too heavy to be taken up the mooring buoy should be taken from the chain and a cheap wooden spar or pole should be substituted. This will resist the action of ice and winter storms better than the keg or can buoy, and if it is lost it doesn't amount to much and the chain can usually be picked up again by a grapnel.

In order that you may be able to locate your mooring, if the buoy is sunk or carried away, you should make a note of cross bearings (see Chapter VII) so that you will know the exact spot where the mooring is located.

There are many forms of moorings for small boats, among them large stones, heavy pieces of iron or

metal, such as old furnace-pots, old car-wheels, old railroad-rails and discarded machinery, while large anchors, and especially "mushroom" anchors, are widely used.

It doesn't make the least difference what is used for a mooring as long as it is heavy enough to hold the boat securely, but it must be borne in mind that an object under water weighs far less than when out of water and hence you should always use an object which you are sure is large and heavy enough to hold your boat in any wind or weather. A mooring should weigh at least three times as much as an anchor and six or eight times as much is none too heavy.

From the mooring a heavy iron chain should lead to a buoy and the chain should be long enough to allow for the rise and fall of tide and yet have some slack at all times.

Galvanized chain should be used and the buoy at its upper end should be large and buoyant enough to support the entire weight of the chain.

There are metal buoys, made for the purpose; a strong keg, such as a beer keg, makes a good buoy; a spar buoy or a cork float may be used. If a keg is used it should be provided with brass or galvanized hoops and should be kept well painted and spars, metal buoys or cork floats should also be taken up, dried and painted at frequent intervals to prevent them from becoming overgrown with marine plants, waterlogged or destroyed by teredos.

The buoy is intended to support the chain and to make the location of the mooring plain. You are *not*

supposed to make your boat fast to it. For fastening the boat a ring should be provided on the chain below the buoy and the buoy left floating or it may be placed on the deck or inside the boat when the mooring is in use. Have your mooring buoy painted in bright colors so as to be easily visible and see that it is always kept in such good shape that it floats high and plain above the water. It's a very easy matter to miss a buoy in a fog, at night, or even with a sea running, and the higher it floats and the more brilliant the colors, the more readily you can "pick it up."

When you come to the mooring you may catch the buoy by hand or by a boat-hook. To make this easier a large loop of rope or a ring should be provided on the buoy and the buoy left floating or it may be and you use a boat-hook, be very careful not to punch a hole in the buoy as you reach for it with the hook.

While getting your boat ready for the water, while sailing her, and, in fact, whenever you are handling or working about boats, you will find it necessary to tie many knots.

Everyone can tie some sort of a knot, but comparatively few can tie really good knots and as they are very important and useful, you should learn how to tie all the common, and some of the fancy, knots and should know how to splice. There is a good portion of the year when you cannot use your boat and during this season you can employ a great deal of your time to good advantage in studying the next chapter and following the directions for making knots, ties and splices.

CHAPTER VII

MARLINSPIKE SEAMANSHIP

To sailors the ability to tie knots, make splices and do other ropework is known as marlinspike seamanship. The name "marlinspike" refers to a metal instrument used in making knots and splices and this tool, or a somewhat similar but smaller implement known as a *fid,* is the only article except the ropes which is required in making any knot, tie or splice.

There is a vast difference between tying a *knot* and tying a *good knot,* and while the one is an abomination, the other is a thing to admire. To be a good knot a knot must combine a number of important points. It must be of such a character that it can be quickly and easily tied; it must hold securely without danger of slipping or loosening; it must be free from the danger of "jamming"; it must be easy to untie or cast off, and it must be perfectly adapted to the particular purpose for which it is used.

The advent of wire rigging and steamships marked the decline of marlinspike seamanship and today a

great many so-called sailors are woefully ignorant of any but the simplest knots and ropework. On the old square-riggers and in the days when sailing vessels were supreme upon the seas, the sailors prided themselves upon their knowledge of knots and splices. To-day one may now and then find an old deep-water tar who can tie every knot and make every splice ever used aboard ship, but each year these men are becoming fewer and marlinspike seamanship, unless kept alive by those who sail boats for pleasure, will soon be a thing of the past.

Before commencing to tie knots or to make splices one should learn about the various kinds of rope and the names of the rope's parts.

Ordinary rope is known as *three-stranded* and is made of three pieces, or strands, twisted together. These run from *left to right* in a spiral and each of these several strands is made up of smaller pieces known as *yarns,* which are twisted together from right to left or *left-handed.* Other ropes are made of four strands, while *bolt-rope* has a central strand around which the other strands are *laid* or twisted. Some ropes are laid up *left-handed* with each strand composed of yarns twisted *right-handed,* but when made in this way the rope becomes a *cable* or a *cable-laid* rope.

The ropes ordinarily used are the three-stranded, right-hand kinds and they may be made of cotton, jute, Manilla or hemp, the Manilla being the best and most widely used.

Small ropes are usually termed *lines* by sailors, and

one never hears a seaman speak of "string." Instead he says "twine," "line," "yarn," or "marline." *Twine* is small right-handed line. *Spun-yarn,* or yarn, is loosely laid, left-handed hemp, tarred and rubbed down. *Marline* is line made of two finely dressed hemp yarns laid left-handed and usually tarred.

Whenever a rope is used for tying a knot or making a splice certain terms are employed to designate the various parts and as these names are used in the directions for making knots you should become familiar with them.

The principal portion or longest part of the rope is called the *standing part;* the portion bent or curved is the *bight,* and the shorter portion used in making the knot or splice is the *end.* Fig. 1.

There are various types of knots, some employed for everyday useful purposes and some for purely ornamental uses. As the former are the easiest to make and are most important, it is a wise plan to learn how to tie them before attempting to master the more difficult ornamental knots.

Before commencing to work with a rope the loose strands at the ends should be *whipped* to prevent the rope from unraveling. To *whip* the rope take a piece of soft, strong twine, lay it on the rope an inch or two from the end, pass the twine several times around the rope, keeping the ends of the twine under the first few turns to hold it in position, and then make a large loop with the free end of the twine. Bring this back to the rope, continue winding it for a few turns around the rope and the end of the twine and finally finish

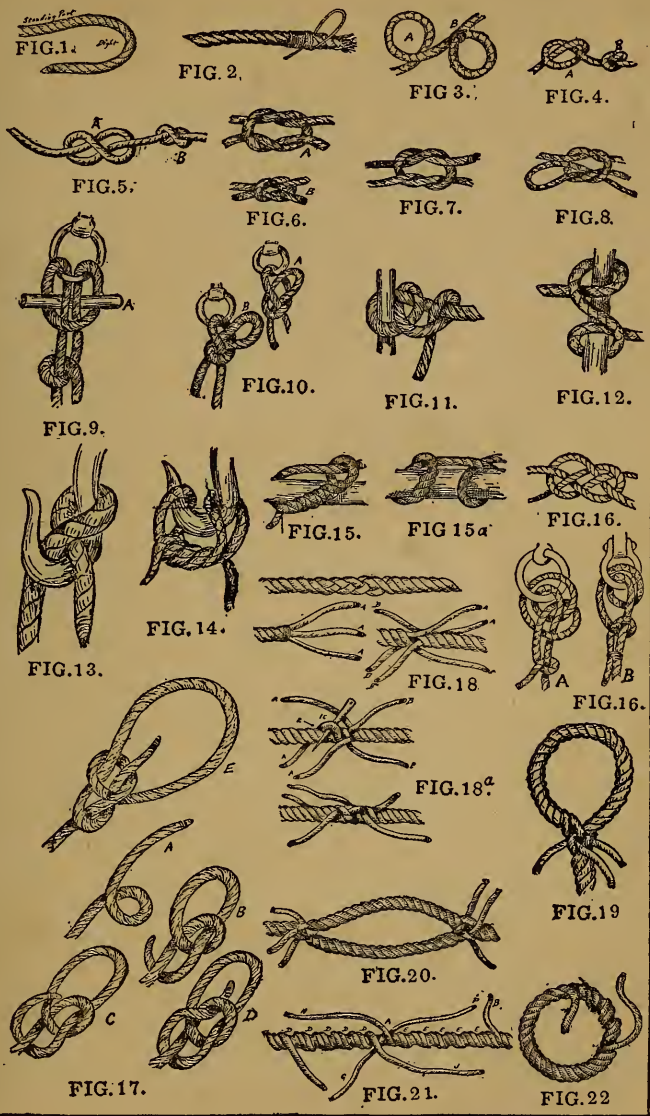


FIG.1.
FIG. 2.
FIG 3.
FIG.4.
FIG.5.
FIG.6.
FIG.7.
FIG.8.
FIG.9.
FIG.10.
FIG.11.
FIG.12.
FIG.13.
FIG.14.
FIG.15.
FIG 15a
FIG.16.
FIG.18
FIG.16.
FIG.18a
FIG.19
FIG.20.
FIG.17.
FIG.21.
FIG.22

by drawing the loop snug by pulling on the free end as shown in Fig. 2. This is the true sailor fashion of whipping a rope's end, but for mere temporary purposes when practising ropework, twine wrapped a few times around the rope and tied will be sufficient.

Cuckold's necks are loops or rings of rope such as are illustrated in Fig. 3. They are very easily made by bringing the end of a rope around in a circular bight and then seizing the bight to the standing part by means of twine or yarn. As soon as the two parts are thus bound together or seized the *cuckold's neck* becomes a *clinch* which is often very useful about a boat, while the loop or cuckold's neck itself is the foundation of many useful knots.

Of all true knots perhaps the simplest is the *overhand knot* (Fig. 4). To make this knot merely pass the end of the rope over the standing part and through the bight or cuckold's neck thus formed (Fig. 4 A). When drawn tight the knot appears as in Fig. 4 B and is often used in making splices, grommets and fancy knots.

Another useful and very simple knot is the *figure eight* which is shown commenced in Fig. 5 A and completed in Fig. 5 B, but the most useful and important of all is the *square knot* or *reef knot* shown in Fig. 6. This is the knot used to tie reef points, to furl sails, to fasten two lines together and for many other purposes, and it is doubtless the best all-around knot known. It has the advantages of being easy to tie and untie, of holding fast under tremendous strain and of never becoming jammed.

To tie a reef knot take one end of the rope in each hand, pass the *left* over and under the *right* and then pass the *right over and under the left.* If you will always remember this formula, *left over, right over,* you will never make a mistake and tie a granny (Fig. 7). To make a granny knot stamps you as a landlubber, for the granny is a useless, troublesome knot which can never be depended upon and which is unfit for any purpose. It will not hold a strain, it is liable to slip and it soon becomes jammed and hard to untie.

If when tying a reef knot, the bight of one end is used instead of the end itself, a *slippery reefer* is made and this is far better for tying reef points than the true square knot as it may be cast off by merely pulling on the free end of the loop (Fig. 8).

When fastening a boat or any other object where it may be necessary to cast off quickly, a *lark's head* is a good fastening to use (Fig. 9). To make this knot pass the bight of a rope through the ring or other object to which you are making fast and then slip a piece of wood, a marlinspike, or some other object through the sides of the bight and under or behind the standing part as shown in Fig. 9 at A. The end of the rope is then laid over and under the standing part and back over itself. This knot may be instantly unfastened by merely pulling out the bit of wood or *toggle* (*A*).

Another knot, which is easy to cast off and is very useful in many places, is the *slippery-hitch* (Fig. 10). To make this knot run the end of the rope through the ring or eye, then back over the standing part and pull

the loop or bight back through the cuckold's neck thus formed. To untie merely pull on the free end.

A better knot for fastening a boat or other object quickly and securely is that shown in Fig. 11. This is made of two half-hitches and is widely used by sailors and is the easiest of all reliable and secure knots to tie. It is made by passing the end of a rope around a post or other object, then carrying the end over and around the standing part between itself and the post and then under and around the standing part between its own loop and the one first made. It is easier to learn this knot by studying the diagram than by a description, and as soon as you get the "hang" of it you can tie it in an instant in the darkest night. It will hold forever without working loose and even on a smooth stick or spar it will stand a great strain without slipping along.

A better knot for fastening to such an object as a smooth stick, where there is a longitudinal strain or to another rope, is the *clove hitch* (Fig. 12). To make this, pass the end of the rope around the stick or other object, then over itself, then over and around the spar and pass the end under itself and between the rope and spar as shown in the diagram.

If you have occasion to fasten a rope to a hook for hoisting anything you should use the *blackwall hitch* (Fig. 13), which is very secure and easily made. To make this hitch form a loop or cuckold's neck with the end of the rope underneath and then pass it over the hook so that the standing part bears against the end and jams it fast.

Still another strong knot for attaching a rope to a hook is shown in Fig. 14. This is called a *catspaw* and is made as follows: Lay the bight of the rope over the end and standing part; then, with a bight in each hand take three twists *away from you;* then bring the two bights side by side and hook them over the hook as shown.

For towing a spar, mast or a piece of timber, or for fastening to a log, the best knot to use is the *timber hitch* (Fig. 15). This is made by passing the end of the rope around the object, then around the standing part and then twisting it three times under and over its own part. If you wish to have this still more secure, a half-hitch may be taken with the line a foot or two farther along the spar (Fig. 15 A).

It often happens that one needs to fasten two very heavy or stiff ropes or hawsers together and this may be impossible with any ordinary knots. In such cases there is nothing better than the *carrick bend* (Fig. 16). To make this bend, form a bight by laying the end of the hawser on top of and across the standing part. Then take the end of the other hawser and pass it through this bight, first down and then up over the cross and then down through the bight again, so that it comes out on the opposite side from the other end thus bringing *one end on top* and the *other below* as illustrated. If the lines are very heavy or stiff the ends may be seized to the standing parts by twine or marline.

Heavy hawsers can seldom be handled like small ropes and there are several bends or knots which are

especially designed for these large ropes. Among them are the *anchor bends* shown in Fig. 16 A and the *fisherman's bend* (Fig. 16 B), both of which are so simple that an explanation is not necessary as they can readily be mastered by looking at the diagrams.

But of all knots perhaps the most perfect is the *bowline* (Fig. 17). This is preëminently *the* sailor's knot and every person who uses or owns boats should learn to tie a bowline quickly and readily for it is the strongest, most secure and best of all useful knots and can be used for a thousand and one different purposes.

It is very simple and by following the various stages as illustrated you will have no difficulty in learning to tie it. In A the rope is shown with the bight or cuckold's neck formed with the end over the standing part. Pass A back through the bight, under, then over, then under again, as shown in B; then over and down through the bight, as shown at C and D. Then draw tight as at E.

While for most purposes knots serve every purpose for fastening two ropes together or for attaching a rope to some other object, yet a tied rope is never as strong as a whole rope and moreover where two ropes are thus fastened together, the knot will not pass through blocks, eyes or other openings which will admit the rope itself. For this reason it is often necessary to join two ropes so that there is scarcely any increase in the size of the ropes. This is accomplished by making what is known as a *splice*.

A splice, if well made, is as strong as the rest of the rope; it will run through a block or eye readily and

moreover it is not difficult to make. There are various kinds of splices, known as *short splices, eye splices, cut splices, long splices,* etc., and everyone who has occasion to use ropes should be able to make any or all of these.

The simplest splice, and the one you should learn first, is the *short splice* (Fig. 18). To make this untwist or *unlay* the ends of the two ropes to be joined for a few inches and wrap a few turns of twine or yarn around them to prevent the strands from untwisting any farther, as shown at A, A. The end of each strand should also be whipped or seized to prevent unravelling, but after you are adept at splicing you can omit these seizings as you will be able to splice just as well, but while learning you will find them quite necessary.

You will also find it far easier to learn how to splice if you wax or grease the strands and this applies to ropes which are used when practising simple or fancy knots also.

When you have the ropes ready, place them end to end, as shown in B, B, and with a marlinspike, a pointed stick, or some smooth, round, sharp tool open the strand 1 C and through this push the strand A of the other rope. Next open strand 2 and pass the next strand of the other rope through the opening and treat the third strand in the same way. Now open the strands of the second, or right-hand, rope below the seizings and push the strands of the first, or left-hand, rope through the apertures. The two ropes will now appear as in D, D. Next untwist each

strand, cut off about one-half of the yarns, twist the strands tightly and seize with twine. Each of the reduced strands must now be poked under the whole strands of the opposite rope in the same manner as you passed the whole strands before cutting them down. After drawing each strand tight, pass them once more under the whole strands and finally trim them off close to the rope.

If a really fine, neat splice is desired, you may trim off a few of the yarns in each strand every time they are passed under the others, thus gradually tapering the ends and in this way forming a splice which is scarcely distinguishable from the rest of the rope.

An *eye splice* (Fig. 19), is made in the same manner as the short splice but instead of splicing the two ends of separate ropes together the end of the rope is unlaid and then bent around in a loop and the ends are spliced into the strands of the standing part as show in the illustration.

A *cut splice* (Fig. 20), is made in a very similar manner but instead of bending the rope around in a bight two ropes are spliced together overlapping, or a short rope may be spliced into another rope at both its ends.

Where a very strong splice the same diameter as the rope is required a *long splice* must be used (Fig. 21). This is the most difficult of all splices to make and it is even harder to describe than to make, but when well spliced it will pass through a block or eye as readily as a plain rope and the splice cannot be distinguished from the rope itself.

To make a long splice unlay the strands of the ropes about four times as much as for a short splice, or from four to five feet, and unlay one strand in each rope for half as much again. Place the center strands together, as at A, so that the long strands appear as at B and C and the spiral groove, left where they were unlaid, will look like D, E. Take off the two middle strands F, G, and lay them into the grooves D, E, until they meet B, C, and be sure to keep them tightly twisted while doing this. Then take the strands H, J, cut off half the yarns in each, make an overhand knot in them and stick the ends in as in making a short splice. Do the same with strands B, C, and F, G, dividing, knotting and sticking in the ends. Finally stretch the rope, pound and roll it until smooth and trim off any loose bits and ends of yarn close to the rope.

While making any splice or knot where the strands are unlaid and are again laid up, be sure to keep the strands tightly twisted by turning them *from right to left.* Then when they are laid in place they will hold their position snugly by their tendency to untwist. If you examine a rope carefully you will discover that the various strands are *not* merely twisted together, but that two of them are twisted and that the third is then laid into the groove between the other two. In laying up a rope after making a knot or splice this should be borne in mind.

Sometimes a ring of rope is required and this can be quickly and easily obtained by making a *grommet* (Fig. 22). To make a grommet unlay and cut a long

strand from a common rope, bend it around in a circle of the desired size, lay one end over the other and with the long end follow the grooves or *lay* of the strand until it comes back to where it started, thus forming a ring of two strands. Continue laying the free end into the groove between the two strands until the ring is completed with three strands all around and then finish by dividing the yarns of the two ends where they meet, making overhand knots in them and then passing them underneath the nearest strands, as when making a splice, and finally trim off all loose, projecting yarns.

These grommets make very good quoits and they may also be used as handles to chests and boxes, rings for masts of small boats and for many other purposes.

After the common useful knots and splices have been thoroughly mastered it is well to learn how to make a few ornamental knots and ropework. Many of these are really useful about a boat while others add greatly to the neat, yachty appearance of ropes, rigging, etc.

At first sight most ornamental knots appear very complicated and difficult, but they are really no harder to tie than a bowline or a reef knot, once you know how.

In tying fancy knots you will find cotton rope or very fine hemp better than Manilla, but after you are really skillful you will find no trouble in forming any knot in any old rope that is handy.

The two most important of fancy knots and those which are the foundation of many others are the *crown,*

(Figs. 23, 24) and the *wall,* (Figs. 25, 26). The *Matthew Walker,* (Fig. 32) and the *Turk's head,* (Fig. 33) are also very beautiful and useful knots and by the use of these four and their various combinations an endless number of fancy knots may be devised. Many of these combinations of two or more knots have become so generally used that they have received specific names and are now recognized as regular knots. Such are the *wall and crown, double wall and crown,* etc.

In addition to true ornamental knots there are various other forms of fancy ropework, such as *worming, parcelling, serving, sennett work, thumming,* etc., while *four-stranded and crown-braids* are used in making ornamental lanyards, hand lines, rope fenders, etc.

The simplest of ornamental knots is the *crown* and it is well to commence with this. Unlay the strands of the rope for a few inches. Seize or whip the ends of the rope as when making a short splice. Now while holding the rope in your left hand, fold one strand over and away from you as in A, Fig. 23; then fold B over A and while holding these in place with your thumb and finger pass C over B and through the bight of A, as shown in the cut. Now pull the ends tight and work the bights up snugly and your knot will be the *single crown,* but as this is a poor knot to stay tied and is not very ornamental, it should be finished by tucking the free ends under and over the strands of the rope as shown in Fig. 24, meanwhile tapering them down as described in the directions for making an eye splice.

FIG. 23.

FIG 24.

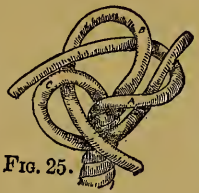


FIG. 25.

FIG. 26.

FIG. 27.

FIG. 30

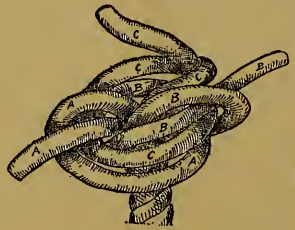


FIG. 32.

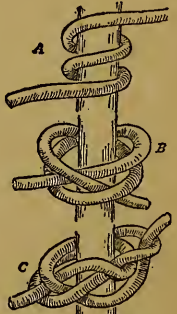


FIG. 33.

FIG. 28.

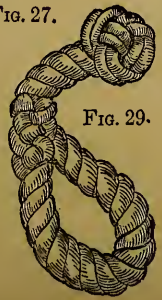


FIG. 29.

FIG. 31.

This results in a very neat and ship shape finish for a rope's end and as it will never work loose like a seizing and can be tied in a very few moments, it can be recommended as the handiest and best of all methods for finishing the ends of ropes to prevent unravelling.

As simple as the crown and far more attractive, is the *wall knot,* Figs. 25, 26. In making this knot unlay and whip the rope as for the crown and make a bight in the strand C by bringing the end down and across the standing part. Then bring strand A over C and around the standing part, and finally bring B over A and up through the bight of C. Draw all the ends tight and snug and the *single wall* will be finished. As in the case with the *crown knot,* this is mainly of value as a basis for other knots, or for ending rope by tucking in the ends as shown in Fig. 26.

By "doubling" the wall or crown, the knots are made far more ornamental. This is done by *following the lay* of the single knot, or in other words, after the single wall or crown is made the strands are carried around side by side of themselves. To make a *double wall knot* make the single knot and then, before drawing it tight, bring the strand A up through its own bight beside the end of C. Then bring B up through its own bight beside A and carry C up through its own bight beside B. When drawn tight it will be very neat. The ends may be trimmed off or tucked through the strands of the standing part as preferred. (Fig. 26.)

A still more ornamental knot may be formed by

crowning a wall knot. This is done by first making a plain wall knot and then bringing A up over the top, laying B across A and bringing C over B and through the bight of A, or in other words, tying a crown knot on top of a wall knot, (Fig. 27).

This is the foundation for one of the most beautiful of rope-end knots which is known as the *double wall and crown* or *manrope knot.* (Fig. 28.) To make this, tie the single wall, crown it and leave the strands slack. Then pass the ends under and up through the bights of the single wall knot and then push the ends alongside of the strands whch form the single crown knot, passing them through the bights in the crown and down through the walling.

If you have learned the single wall and single crown, you will find this very simple, for it consists in merely following the lay of the strands of the single wall and crown. When well done and worked up tight and snug with the ends trimmed off closely it makes a highly ornamental knot, (Fig. 28), and if the ends are tucked into the standing part, as directed for tying the single crown, there should be no sign of a beginning or ending to this knot, the finished result appearing like an ornamental knob of rope.

This is a useful as well as an ornamental knot and is handy in many places on a boat. It is often used in finishing the ends of rope railings, the ends of manropes (hence its name) for the ends of yoke lines for steering small boats, to form *stoppers* or *toggles* to bucket-handles, slings, etc., and in fact, wherever a large ornamental end to a rope is required or where

a knot is desired to prevent a rope from slipping through any aperture.

Its use for such purposes is shown in Figs. 29, 30 and 31 which represent topsail halyard toggles, formed by turning an eye splice in a short length of rope with a double wall and crown at the end. Such toggles are useful for many purposes other than for topsail halyards. They may be used as stops for furling sails, for slings around gaffs or booms, for attaching blocks when hoisting and in many other places which will suggest themselves to the user of a small boat.

Another very beautiful end knot, and the most difficult of all to make is the *Matthew Walker* or *stopper knot* (Fig 32). To tie this knot pass one strand around the standing part and through its own bight, then pass B underneath and through the bight of A and through its own bight as well. Then pass C underneath, around and through the bights of A, B and its own bight. The knot will not appear as at Fig. 32A, but by carefully hauling the ends around and working the bights up tight—a little at a time, the knot will assume the shape shown in Fig. 32B. This is a splendid knot for the ends of ropes to prevent them from slipping through holes, as it is hard, close and presents an almost flat shoulder on its lower side. It is because of its adaption to such purposes that the name "stopper knot" has been given to it.

All of the preceding are end knots, but a knot of a very different sort, which is widely used for ornamenting ropes, is the *Turk's head* (Fig. 33). Turk's heads are used in decorating lower standing rigging, for rings

or shoulders on shrouds or ropes, to secure other rigging in position, to ornament yoke lines, for forming sliding collars on knife lanyards and for collars around stanchions, spars, oars, etc., and when placed around a rope close beneath a manrope or Matthew Walker knot it gives a very beautiful and elaborate finish to a rope.

Although so handsome and apparently intricate, the Turk's head is a very simple and easy knot to make and while you may have some difficulty in mastering it at the first a little practice and perseverance will enable you to become proficient and you will be able to tie this beautiful knot at any time and in any position.

To learn to make this knot obtain a smooth, round stick and some closely twisted, or braided, small line. Pass two turns with the line around the rod, as at A, Fig. 33, pass the upper bight down through the lower bight and reeve the upper end down through it, as at B, Fig. 33. Then pass the bight up again and pass the end over the lower bight and up between it and the upper bight. Dip the upper bight again through the lower bight and pass the end over what is now the upper bight and between it and the lower one, as at C, Fig. 33. Continue to work around in this manner to the right until the other end is met when the other part should be followed around until a plait of two or more lays is complete as shown in the cut.

The various bights should then be drawn snugly until there is no slack and the completed knot fits tightly about the rod. A variation of this knot may be formed by making the first part as directed and then by slipping

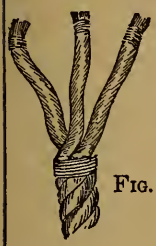
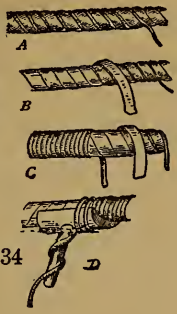


Fig. 34



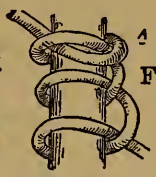


Fig. 35.

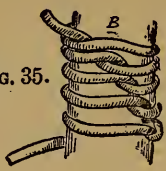


Fig. 37.

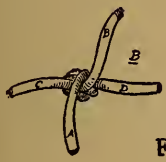


Fig. 36.

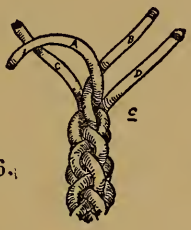


Fig. 39.

Fig. 38.

Fig. 40.

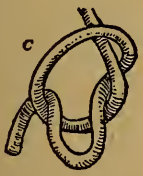


Fig. 41.

the knot to the end of the rod work one side tighter than the other until the plaits form a complete cap (Fig. 33D). This makes a fine finish for the ends of stanchions, poles, flagstaffs, etc., and it may be kept in position by a few tacks or small nails driven through the inner strands into the woodwork.

Ropes that are to be used as handlines, stanchions, manropes, lifelines, shrouds or, in fact, for any purpose where appearances count, are usually *wormed, served* and *parcelled*. *Worming* consists of twisting a small line or filler into the grooves and making the rope smooth and ready for parcelling or serving. *Parcelling* is done by wrapping the wormed line with a narrow strip of canvas (Fig. 34B), and finally the whole is *served* by being wrapped tightly with marline or spun yarn (Fig. 34C).

Although all this may be done by hand the serving is usually accomplished by means of a tool known as a serving mallet (Fig. 34D). This instrument enables one to work much more evenly and tightly than is possible by hand serving, but whether a mallet is used or you depend upon hand serving, the rope to be treated must be stretched tightly between two uprights or the result will never be satisfactory. Sometimes a rope is served without either worming or parcelling and for ordinary purposes the parcelling is not necessary; although the results obtained by performing all these operations are very much more satisfactory.

A variation in serving is made by means of *half-hitch* work as shown in Fig. 35. This is very ornamental when well done and is very simple and easy to

accomplish. To make this covering, take a half-hitch with the small line about the rope, then another below it, draw snug, take another half-hitch and continue in this way until the rope or other object, is covered and the half-hitches form a spiral row of knots running around the covered object. Bottles, jugs, ropes, stanchions, fenders and many other articles may be covered with this half-hitch work and as you become expert you will be able to cover objects with several alternating rows of half-hitches.

Four-strand braiding is also highly ornamental and is very simple. To do this (Fig. 36), merely cross the opposite strands of small lines as illustrated in A, B, Fig. 36B, first crossing A to the left of B, then crossing C and D above A and B and continue in this way until the braid is the desired length.

Still more decorative is a *crown braid*, which is made by forming one crown knot over another.

A *wall braid* may be made by forming a series of single wall knots in the same way and either the crown or wall braiding may be done with any number of strands or lines desired; the more strands used the finer and more ornamental will be the braid produced.

Sometimes the *monkey chain*, Fig. 38, is used for ornamental work, but it is more useful as a means of shortening rope in such a manner that it may be quickly lengthened out for use. To make the *monkey chain* draw a loop of the rope through its own bight as at A, B, Fig. 38; draw another loop through this (C, Fig. 38), another through this (D, Fig. 38), and continue in this way until the rope is shortened as much as

desired, when the end may then be passed through the last bight as shown at E, Fig. 38. If left in this way the chain will never come loose and yet the rope may be lengthened instantly by slipping out the end and pulling upon it whereupon the entire chain will ravel.

Once having mastered these various knots and splices you will find little difficulty in selecting and tying the best knot for any purpose which may arise, but no description of knots would be complete without a few hints on slinging barrels, casks or other objects.

Three of the best and simplest slings are shown in Figs. 39, 40 and 41. The first, Fig. 39, shows a handy and useful sling for bags or bales and consists of a strap or length of rope with the two ends spliced together and slipnoosed around the object as shown. A large grommet also makes a good sling of this type. Fig. 40 shows how to sling a cask or barrel in an upright position when it contains water or other contents, while in Fig. 41, a sling for hoisting barrels, boxes or other articles is illustrated. In this case the rope may be used with an eye splice at one end as shown, or it may be merely tied with a bowline or other good knot. Sometimes a sling is used which has an eye splice at each end and if you have one or two slings readymade with finished ends, or with eye splices turned in them, you will find they are very useful and will save a lot of time and trouble, for they can be used for many purposes other than as slings.

CHAPTER VIII

SIMPLE NAVIGATION

Among the first things that the amateur sailor should learn are the rules of the road at sea, for there are just as strict and definite rules for boats traversing maritime highways as are in force for vehicles using highways on the land.

But whereas traffic rules ashore vary in different countries, and even in the various states and cities, the rules of the road on the water are alike throughout all the world, and if you learn the rules in force in American waters, the knowledge will serve just as well in the waters of any other country.

The first and principal rule is to *turn to the right when meeting another boat.* At times this may be impossible and hence signals and rules have been arranged which provide for turning to the left when necessary, but sailing boats *always* have the right of way over steamers and power boats. It does not follow, because this is the case, however, that a man in a small sailboat should compel a larger vessel to give

way to him and endanger the other ship for it may be impossible for the larger craft to turn out, owing to the narrow channel or some similar reason, and hence you should know what the various lights and signals mean and should be prepared for any unusual condition which may arise.

In order that sailors may know in which direction a vessel is proceeding at night, as well as the character of the vessel, all vessels carry what are known as *side lights,* the one on the right or starboard side being green, while that on the port or left side is red. If you remember that the *port* light is *red* like *port wine,* you will never become confused as to which color is port and which starboard. These lights are only used when vessels are sailing or under way and when at anchor or at moorings, a white light or *riding-light* is placed in the rigging.

Steamers and power boats carry a white light near the stern and another white light forward. The rear white light is visible from all directions and is high up, while the forward white light is visible only from one side around a half-circle to the other side of the bow, while the side lights can only be seen from ahead or from either side.

By these lights you can always determine the direction in which a vessel is moving and can thus keep clear. If she is approaching bow-on, you will see *both* the side lights and you can be sure she is a power boat or steamer if you see the two white lights. If the two white lights are not in exact line, you will know that she is turning and the direction she is head-

ing is easily determined, for if the *low bow light* is to the *right* of the high stern light she is turning to your *right,* while if it appears at the *left* of the higher stern light she is heading to your *left.* If only one side light is seen you may be sure the vessel is moving at right angles, or at nearly right angles to your course, and if she is a power-propelled vessel you can easily tell the angle at which she is moving by the position of the white lights. If a steamer or power boat is ahead of you and moving in the same direction, you can see only the high white stern light and the instant she turns you will know it by the other lights becoming visible.

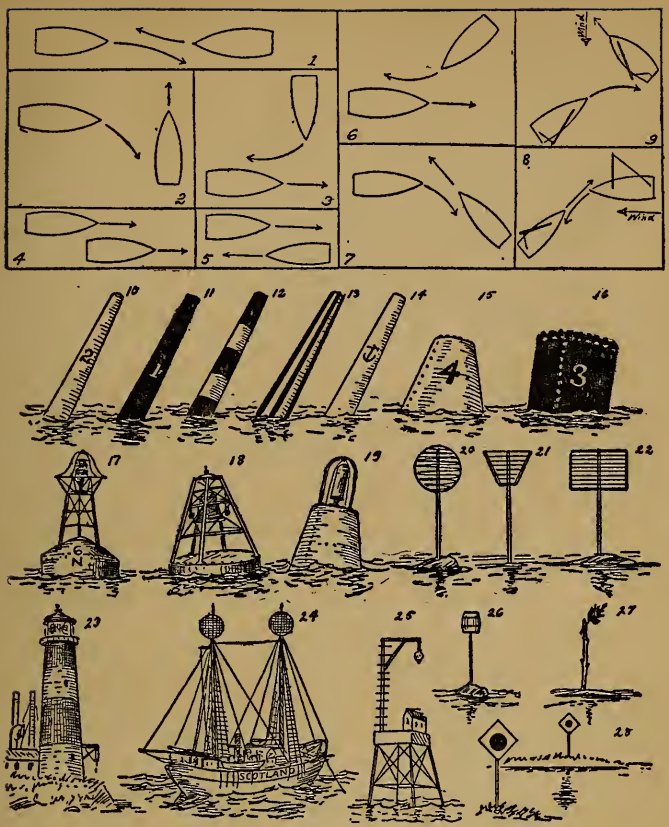
Steamers and power boats also have signals which are given by the whistles to show which way they wish to proceed and the steamer which signals first dictates the direction. One blast means the vessel is turning to her *starboard* or *right* hand and *two blasts* signifies she is going to her *left* or *port,* and while such signals should be answered by other power or steam boats, sailing craft are not supposed to reply. Unless there is some unusual reason for not following the ordinary rules of the road, a steamer or power boat will never signal to a sailboat and hence, if a steamer is approaching or overtaking you, and whistles, you should look about and be sure she is not signalling some other steamer for *all* power and steam vessels are supposed to keep clear of sailing craft. Naturally they expect the sailing boats' helmsmen to know the rules of the road and, therefore, if you think their signals are intended for you and change your course the steamer may not

know why you are doing such an unexpected thing and a collision may result. If you adhere strictly to the rules of the road there is no reason why you should *ever* have an accident through your own fault, but if a power boat or steamer is approaching and does not show signs of giving way to your right of way you should blow a horn, halloo, shout or do something to attract attention and if necessary go about and get out of the way as soon as possible.

During thick weather, in fogs, mists, snow and heavy rain, sailing vessels signal the direction in which they are moving by means of blasts on a foghorn. If they are on the *starboard* tack, that is, with the wind on the right or starboard side, *one* blast is blown at intervals of about a minute, if on the *port* tack, *two* blasts are blown at intervals, while if running *before* the wind *three* blasts are sounded. As you can always tell the direction of the wind by your own sails, you can easily determine the direction in which the other boats are headed by their signals and can thus avoid them.

Always remember that a sailing vessel on the *starboard tack has the right of way over a vessel on the port tack,* and that a vessel sailing *close hauled or against the wind has the right of way over a vessel running free or on the wind* regardless of their size, the direction in which they are moving or anything else.

In order to make the primary rules of the road easier to remember they have been made into verse and some of these simple verses, if memorized, will prove a great help.



Rules of the Road and Buoys

1—Meeting head-on, turn to starboard. 2—Crossing, boat to starboard has right of way. 3—Crossing, boat to starboard has right of way. 4—Passing. 5—Meeting, Green to green, hold course. 6—Meeting at angle, boat to starboard has right of way. 7—Meeting at angle, boat to starboard has right of way. 8—Boat on wind has right of way over boat sailing free. 9—Boat on starboard tack has right of way. 10—Red spar buoy, pass on starboard when entering harbor, on port when leaving harbors. 11—Black spar buoy. Leave on port when entering and on starboard when leaving harbors. 12—Horizontal red and black buoy. Danger, keep clear. 13—White and black striped buoy. Midchannel, keep close to it. 14—Anchorage buoy. 15—Nun buoy. 16—Can buoy. 17—Gas buoy. 18—Bell buoy. 19—Whistling buoy. 20—Perch and ball. 21-22—Beacons. 23—Lighthouse. 24—Lightship. 25—Light beacon. 26—Keg beacon. 27—Channel mark. 28—Range marks.

When meeting a vessel head-on you are supposed to turn to the right as the following verse shows:

When two lights you see ahead
Port your helm and show your red,

or in other words, put your tiller to port and turn your boat to the right.

If, on the other hand, a vessel is passing side-to you will see but one light and the following verse tells you that

Green to green, or red to red
Perfect safety—go ahead,

or, in other words, if you see a *green* light on your *green* or *starboard* side or a *red* or *port* light on your *red* or *port* side, the other boat is parallel to you and your course should be kept.

The greatest danger is in approaching another vessel at right angles, but in this case remember that the *boat that has the other on the starboard or right-hand side must keep clear of the other,* or, as the verse says:

If to your starboard red appear
'Tis your duty to keep clear,
Act as judgment says is proper,
Port or starboard, back or stop her.
But when on your port is seen
A vessel with a light of green
There's not much for you to do
The green light must keep clear of you

But more important perhaps than all is the universal rule that *all* boats must keep a *good lookout,* and the following verse indicates this:

Both in safety and in doubt
Always keep a good lookout
Should there not be room to turn
Shift your helm and pass astern.

The last line is most important. *Never* under *any* circumstances attempt to *cross the bows* of another moving vessel. If you do and accident occurs it will be your own fault. A boat crossing another's bows *always does so at her own risk.* No matter how you are heading, no matter how much of a hurry you may be in, no matter how much trouble it may involve, if you are approaching another boat of any kind so that your course will cross hers, remember the last verse and *shift your helm and pass astern.*

Another very important matter for all boat sailors to learn is the meaning of the various buoys, beacons, lights and other guide-boards of the sea. In small boats these are often of little importance for one may sail hither and thither without paying much attention to channels, but even in the smallest of sailboats there is a danger of running on reefs, rocks or shoals if one does not know what the guiding marks mean.

In nearly every port, harbor, or other navigable body of water, except in the open ocean, there are buoys. To the landsman these appear as so many red, black or parti-colored sticks or metal cylinders, but to the sailor every one has a definite meaning and he knows that if he proceeds according to the route marked by the buoys he is perfectly safe.

There are two general classes of buoys, known as *channel buoys* and *danger buoys.* The first are used

to mark lanes or channels for boats and are always black or red in color. *All* the red buoys are placed on one side of the channel and *all* the black buoys on the other side and every boat, when coming in from sea or *moving towards the land should keep the red buoys on her right or starboard side* and all the *black buoys on her port or left hand.* When going *out* of the harbor or *away from land, the red buoys are passed on the left and the black ones on the right.*

In other words, in *leaving* a harbor all the *red buoys* should be passed on the *red light side of your boat.* Moreover, all the channel buoys are numbered, the black buoys bearing odd numbers, while the red ones are marked with even numbers, so that even if the colors are indistinct you can tell whether they are to be passed on right or left. But all channel buoys are not alike for there are *spar buoys, can buoys* and *nun buoys,* each of which serves a definite purpose and means a certain thing.

Can buoys are cylindrical, like giant tin cans, and are painted black and marked with odd numbers, while *nun buoys* are tapered on the top, are painted red and bear even numbers.

Spar buoys are merely huge, wooden poles painted red or black and bearing odd numbers on the black ones and even numbers on those which are red.

In some places the *can* and *nun buoys* are used to mark the main ship channels and the spar buoys are used to show smaller or less important channels, while in other places only one kind is used or *can* or *nun* buoys may be placed among the spar buoys

to mark turning points or to aid mariners in locating their position in the channel. All the buoys' numbers commence at the one farthest out, which is number 1, for buoys are of more importance to vessels entering a harbor than to those going out to sea.

Danger buoys differ from channel buoys in color and are not numbered and they may be either of the spar, can or nun type. A buoy painted *red and black in horizontal stripes* running round the buoy indicates that there is some small, reef, rock or other obstruction close to it and that vessels must keep clear, *but can pass on either side.* A buoy painted with *vertical stripes of black and white* means exactly the opposite and shows that in order to avoid danger vessels must *pass as closely to the buoy as possible* and that there are shoals or obstructions on one or both sides of the buoy a short distance away. This *striped buoy* also is used to mark the *center of a channel* and is known as a *midchannel buoy.*

Bell buoys and *whistling buoys* are also used to mark danger spots and turning-points in channels. Whistling buoys are metal buoys fitted with whistles which are blown by air forced up by the motion of the waves and are sometimes called *grunters* as the sound is more like a grunt than a whistle. *Bell buoys* are provided with a bell which is rung by the swaying of the buoy. In many places they are located well out to sea to indicate the beginning of a channel; in other spots they are placed on reefs, rocks or other obstructions as warnings, and in still other places they serve to

show where a channel turns sharply or where another channel branches off.

Still another sort of buoy is the *gas buoy.* These serve as miniature lighthouses or lightships and are furnished with lamps which burn compressed acetylene or other gas. They are usually placed on outlying reefs or rocks or in spots where it would not pay to keep a regular lightship.

In many places, where ordinary buoys cannot be used, a large sphere is set up on the end of a pole and painted red or black, according to the side on which it should be passed. This is known to seamen as a *perch and ball.* Often a square, boxlike affair or a cone made of iron or wooden slats is used in the same manner.

In still other localities the government does not think it worth while to establish regular buoys and local fishermen or others use channel marks in the form of kegs set on posts or rods in place of danger buoys and cedar trees fastened on tall posts to indicate the channels.

In many parts of the country *beacons* are used which are tripods or platforms of wood or iron on which lanterns are suspended. Sometimes the beacons are built of stone or concrete.

On navigable rivers and inland waters and in some places on the coasts *range marks* are used. These are square or diamond-shaped frames of boards painted white with a square or circle of black in the center and set on posts. They are placed so that when two come directly in line the boatman knows he is in the

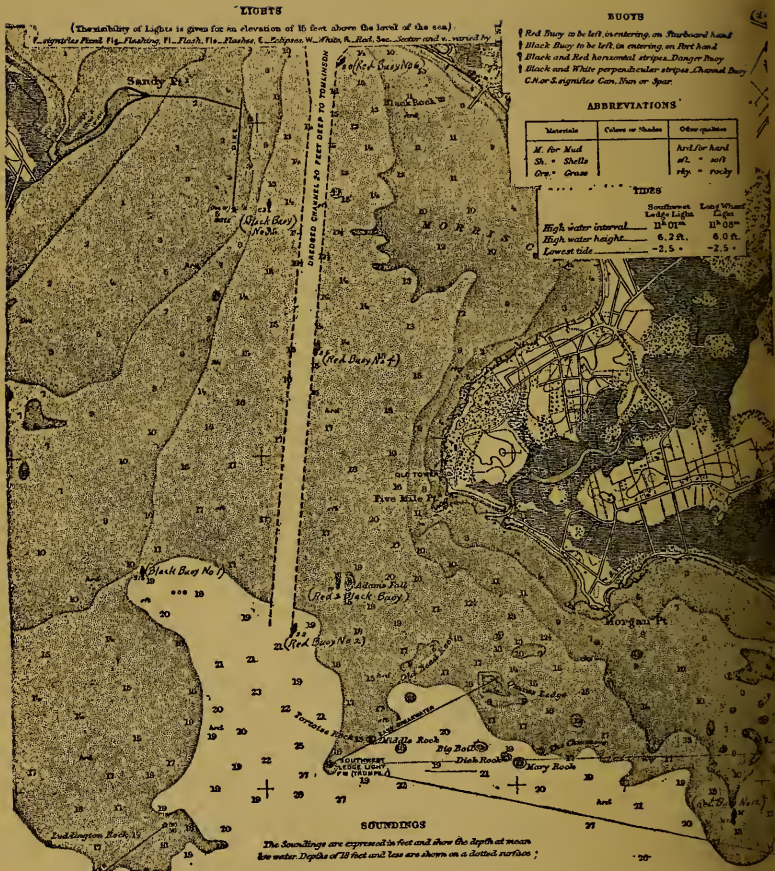
center of the channel. At night lanterns are often hung upon them.

Sometimes one sees a large spar buoy painted *white* and with a *little black anchor* painted upon it. This shows the anchorage for large vessels and indicates that vessels cannot anchor further than the buoy without obstructing a channel or endangering cables, submarine works or other things.

Just as buoys tell the sailor which way to steer in harbors or when close to shore so *lightships* and *lighthouses* show mariners how to sail along the coasts. Lightships are vessels carrying lights at their masthead and are anchored out at sea on shoals or off harbors to show where the channels begin.

Lighthouses are usually built on shore close to the sea, but they are often built on stone, masonry or slender steel supports quite a distance from the land. Each lighthouse has a different light, many are painted in stripes or other distinctive patterns and lightships are numbered and named to enable sailors to identify them easily.

Some lighthouses throw a steady red light, others a steady white light, others flashes of white, others flashes of red, others alternate flashes of red and white, and in many places they are arranged so that a white light is visible from vessels in the channels or in safe waters, while a red sector causes a red light to be thrown over the shallow or dangerous waters. Moreover, the flashing lights have various intervals between flashes and thus, by knowing the colors of the various lights and the duration of their flashes, a sailor



HARBOR CHART SHOWING LIGHTS, BUOYS, CHANNELS, SOUNDINGS, BEARINGS, BOTTOM, ETC.

can determine just where he is by the lighthouses he sights.

All of these safeguards of the sea would be of little value to mariners, however, if it were not for charts, for no man could remember *all* the various buoys, beacons, range marks, lightships and lighthouses of the coasts and the various harbors.

To enable the seaman to know just what every one of these means, and to help him find his way in places where he has never been, charts are furnished by the government. These are maps which show all the buoys, lights, signals and other guides and also indicate the depth of the water, the kind of bottom, the points of the compass, the prominent landmarks, the rise and fall of tides and the outlines of the shores.

With the aid of a chart a sailor can safely find his way into any harbor or along any coast, and even if it is some remote place where there are no lights or buoys, or if the weather is too thick to enable him to see the buoys or lights, the charts will tell him where he is by the character of the bottom and the depth of the water.

It may seem queer to think of a sailor navigating a vessel by the bottom of the sea, but it is a method very widely used and of great importance.

In nearly every place the bottom varies more or less and the waters shoal in a certain way and by finding the kind of bottom there is and the depth of the water the seaman identifies the locality he is in. Thus, if the bottom is white sand and the depth is five fath-

oms, he looks upon the chart and finds the spot where a similar depth and bottom is indicated. Perhaps there are several such spots and the sailor is not sure which one he is on. In that case, he looks in the direction he is sailing and finds that on the chart the water shoals very gradually and that blue mud exists just beyond the spot where he *thinks* he should be. If his next sounding shows blue mud and only a little less depth than before he knows he is right, whereas if it shows deeper water and gravel, or much shallower water and sand, he knows he is off his course and by comparing his soundings with the chart he can tell just where he is.

To determine the depth of water, a sounding line is used with a heavy lead weight at the end and with the fathoms marked upon the line and every time the lead is dropped to the bottom a tiny sample of the bottom is brought up sticking to a little tallow which fills a recess in the end of the lead.

Nowadays there are many improved forms of sounding lines and leads, some of which have very cleverly arranged appliances for bringing up samples of the bottom, but the old-fashioned line and lead is still widely used.

Still other important items which are indicated on the chart are bearings or landfalls. Often some prominent cliff, hill, mountain or other object is visible long before the shores themselves or any lights can be seen, and by bringing certain such marks in line, or by obtaining the direction which they bear to the ship and then referring to the charts, the sailor can tell just what

part of the shore he is approaching and how he should steer to enter a harbor or channel.

But charts, bearings or landmarks would be almost useless without that most important of all mariners' guides, the compass.

Everyone who uses a boat should know how to use a compass and every boat, save the very smallest open boats, should invariably have a compass on board. Even if you never expect to sail far from shore you may some day be caught in a thick fog or blown off to sea for several miles and a compass may save your life and the lives of others. But unless you know how to use a compass this useful instrument will be of little aid. It may seem strange to speak of learning to use a compass for everyone knows that a compass points toward the north, but when an ordinary compass is used on a boat the conditions are very different from using a compass on land. In the first place it is not enough to know the cardinal points of north, south, east and west, for while such general directions may serve on the land, a very slight variation of the course may result in running on a reef or in missing a harbor, when sailing. For this reason you should become thoroughly familiar with *all* the points of a compass and should be able to *box the compass* or repeat all the thirty-two points from north around the circle to north and back again without looking at the compass. Then you should learn the quarter points and should be able to tell at a glance whether the boat is heading north-one-quarter-east or is a quarter of a point off her course in any direction, for a quarter-point error

in sailing may make a vast difference at the end of a few hours' run.

There are two general types of compasses in use: one known as the *pocket compass* or *movable-needle compass,* the other as the *mariner's compass or floating-card compass.* The former is generally used on land and has a fixed card with the various points marked upon it and a movable needle which points to the north, while the mariner's compass has a card with the points which revolves and there is a notch or *lubber's mark* on one side of the case which should be so placed that

USE OF COMPASS IN BOAT

A—Mariner's compass. B–C—Pocket compass.

when facing north the north mark on the card is exactly in line with the lubber's mark.

In a boat the floating-card or mariner's compass is almost a necessity, for with it the boat's bow may be headed in the direction or course desired, whereas with a pocket compass the dial remains stationary and the needle moves about and as a result some mental calculation is necessary in order to steer a course correctly.

This will be better understood by studying the accompanying illustration. In this you will see that at A a boat with a mariner's compass is headed *northeast,* and that if the course is to be altered to any given point of the compass it is merely necessary to turn

until the desired mark is in line with the lubber's mark.

In the diagram B, however, the boat is apparently headed north although the same course is being steered as in A. This is because the compass used is a fixed-card compass with a movable needle and the needle moves as the boat's course is changed, while the card remains stationary, and although the boat is really headed *northeast* the needle points to the *northwest.* In other words, when using such a compass it is necessary to read it backwards and if you wish to steer *northeast* swing the boat until the needle points *northwest,* and so on, for every direction. This, of course, is very confusing and it can be avoided only by shifting the position of the compass so as to bring the needle directly over "north" each time the boat's course is altered as shown at C. By doing this the boat's bow will correspond to the direction being steered, as indicated on the compass card, but it is often very inconvenient, if not impossible, to move a compass constantly while bobbing about in a sea or tacking, although on land it is no trouble to turn the compass until the needle and "north" are in line and then proceed in the desired direction.

Moreover, a pivoted needle is often very erratic and swings wildly when in a boat and for these reasons a floating-dial compass should always be used. Many pocket compasses are made with moving dials, or cards, and these will serve very well for small boats, but they are not to be compared to the true boat compasses for steadiness, accuracy and convenience.

Sometimes one may find oneself without a compass

and may wish to obtain a general idea of direction and in such a case it is of great value to know that an ordinary watch or clock may be made to serve as a compass.

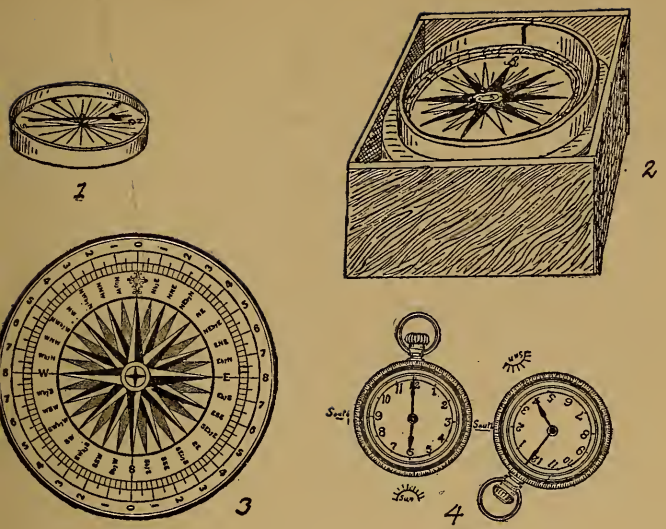
To use a watch as a compass, place it horizontally, with the hour hand pointing directly towards the sun, or until the shadow of the hour hand falls directly beneath the hand itself. When this position is attained south will be exactly halfway between the point of the hour hand and the figure 12; counting from left to right, or southward, if *before* noon and from right to left if *after* noon.

This will prove very accurate for our latitudes during most of the year and the method will be clearly understood by referring to the illustrations in which the watch is shown with the hour hand pointing towards the sun at six A. M. when the figure 9 indicates south, while in the afternoon, with the hour hand pointing at the sun at four o'clock, the figure 2 indicates south.

This method of determining direction is only useful on sunny or bright days, however, and one often needs to know the points of the compass at night, when the watch would be useless.

In any spot north of the equator the North Star, or Pole Star, serves as a guide, while south of the equator the Southern Cross indicates the true south. But the Southern Cross becomes visible long before the equator is reached, in about twenty degrees north latitude, and hence there is a wide area in which both of these stellar guides serve the mariner.

It is a very easy matter to locate the North Star by



COMPASSES

1—Pocket compass. 2—Mariner's compass. 3—Points of compass. 4—How to use a watch as a compass. 5—How to find the North Star.

finding the constellation known as the Great Dipper or the Great Bear. Then by following in a straight line from the two outer stars of the Dipper, the upper one of which would form the lip of the Dipper, or the breast of the Bear, the North Star will be the first bright star in range of these two stars in the constellation and which are known as *the Pointers.*

As the Great Dipper revolves around the North Star the latter may be either above or below the Dipper, but by carrying your imaginary line through the pointers, from the foot or bottom of the constellation and beyond the top, the star may always be located if the night is clear and even if the Pole Star is *not* visible the Dipper itself will serve as a guide to enable you to steer a fairly straight course.

Captains of large vessels, sailing out of sight of land, determine their positions and steer their course by taking observations by means of instruments called *sextants* and by *chronometers.*

The chronometer is merely an extremely accurate clock which is set by standard time with Greenwich, and by comparing the actual time with this at noon, the mariner can work out the distance east or west of Greenwich, or in other words, obtain his *longitude.*

By means of the sextant he determines the exact moment at which the sun crosses the meridian, or the exact noon hour at his locality and he also learns the angle or *declination* of the sun above the horizon. By means of tables he is thus enabled to work out his *latitude,* or his distance north or south of the equator, and then by marking the spot on his chart where the long-

itude and latitude cross, he indicates the exact position of his ship.

It is an easy matter to learn to "shoot the sun" and to compute latitude and longitude. Every amateur sailor will do well to acquire this knowledge, even if it never becomes necessary to use it.

For all ordinary purposes, however, *dead reckoning* will serve and many sailors, and not a few captains of large vessels find dead reckoning sufficiently accurate for their needs if near land or only sailing for comparatively short distances out at sea.

Dead reckoning consists of computing a vessel's position by the distance sailed from one time to another; the drift or leeway made and the directions in which the boat has sailed.

To find the distance sailed it is necessary to multiply the number of hours by the speed per hour. To determine this an instrument called a *log* is used. In former days the log was in reality a log, and consisted of a drag of wood attached to a marked line on a reel. The log was thrown over the vessel's stern and as the line ran out it was timed by a *sandglass* and the number of *knots* on the line which ran out while the sand fell through the glass gave the speed of the ship. Today instruments known as *patent logs* are used which are like small propellers attached to a line connected with a clocklike arrangement, and as the log whirls around by being dragged through the water the hands on the dials indicate the speed of the vessel.

But while the log has been changed to a metal whirler and the line and sandglass have given place to an accu-

rate and complicated mechanism of wheels and cogs, yet the name *log* is still retained and sailors always speak of knots instead of miles.

By marking off the number of knots sailed in the proper direction the sailor might easily tell where he was, provided there were no currents or tides and the vessel moved at a uniform speed and made no leeway. As a matter of fact the ocean is full of currents, streams and tides and moreover a vessel, when sailing, or steaming for that matter, is carried to one side or the other and forwards and backwards by these as well as by the wind.

Besides a sailing vessel moves more slowly or faster according to the strength of the wind and is often obliged to tack or to alter its course to suit the winds.

All of these matters must be considered in working out a position by dead reckoning and the course of a sailing vessel when thus *pricked out* on a chart often looks like the track made by a drunken man, as it zigzags hither and thither, swings about, and varies widely from one side or the other of its true course.

In order to come anywhere near accuracy by means of dead reckoning a mariner must be thoroughly familiar with the tides and currents through which he is sailing. He must be able to judge the strength of the wind; he must know just what his vessel will do under varying conditions; he must be able to guess very closely the leeway she makes, and he must bear in mind all the changes of course, all the tacks and all the shifting of sails which have been made. Only by such knowledge and by long practice can a sailor de-

termine where he is by dead reckoning and even then he can only locate his position approximately. It seems remarkable that any man can come anywhere near the truth by such means but many sea captains have become so expert that they can figure out their position by dead reckoning and come within a very few miles of the right result every time.

Very few amateur sailors will ever need to go into the details of dead reckoning, but it is often convenient to be able to determine roughly where you are and you should strive to become so accustomed to your boat's speed under various conditions that you can guess very closely how far and how fast she has sailed. You should also study the charts of your vicinity and learn all about the tides and currents and should be able to judge of the leeway you are making, as well as to form an accurate idea of the weight of the wind or the speed at which it is blowing All these things are a part of knowing how to sail and handling a boat and they will come in mighty handy sooner or later.

Many a race has been won by a man or boy knowing the currents and tides and taking advantage of them. If you are out in a fog or in darkness your knowledge of winds, currents and other conditions will enable you to steer a true course and reach port, whereas, if ignorant of these simple matters, you might be compelled to drift about for hours until you could see your surroundings.

Until you have tried you can have no idea of how much you can learn about such matters or what a

keen sense of location and direction you can develop. The fishermen on the coast of Maine and other parts of New England know the currents, winds and tides of their waters so well that thick fogs or the darkest nights have no terrors for them. I have seen a Maine fisherman sail his schooner straight for the rocky, reef-fringed coast through the thickest fog and drive into a narrow harbor entrance as surely as if he was following a well marked lane of buoys. Yet nothing could be seen and the roar of surf was deafening and to make a mistake of a hundred feet in his course meant certain death and the loss of the vessel.

These men don't know *how* they know where they are or *how* they are able to find their way blindly on these dangerous coasts when nothing can be seen. They will tell you it's "by the lay of the land," although the land cannot be seen, or they may say they "smell where they are," but as a matter of fact it is owing to their intimate knowledge of conditions and surroundings which has become such a part of their daily life that they are perfectly unconscious of it.

Of course the amateur sailor can scarcely hope to become as expert as these old shellbacks who have spent their lives knocking about in boats, but you can readily learn the bearings of certain places, the location of certain tide-rips and the direction and flow of certain currents in the waters where you sail and these will all help to guide you when sailing in darkness or in fog.

Fog is perhaps the greatest danger that menaces sailors along the coasts, for a thick fog not only hides

all objects and surroundings, but when something *is* seen it is often so distorted, so spectral or so unusual in appearance that it is hard to recognize the most familiar landmarks. Moreover it is next to impossible to judge of distance in a fog and an object, seen dimly through the mist and apparently far away, may be close at hand or again something which looms seemingly near may really be far away. Sound also is distorted by fogs and even old hands are often woefully deceived as to the direction and distance of sounds heard through fog.

Sometimes, too, a fog may settle low and high objects may be visible above it, or again it may lift and hide all objects above a certain height and yet leave things close to the water within plain sight.

In most places the approach of fogs may be readily seen, but quite frequently a fog will come on very suddenly or a light mist may suddenly shut in as a dense fog, while in some places fogs almost always occur at certain seasons or at certain hours and can be expected at such times.

If a fog is seen approaching, or a light mist commences to thicken up, always try to make port before it becomes dense. If you have a compass make a note of the direction you must steer, look about for vessels that may be in your course and note the direction of the wind, the waves and the courses other craft are sailing, if any can be seen.

If you have no compass note the direction of the waves and wind as compared with the course you wish to take, pick out some prominent landmark or beacon

for which you can steer and when the fog shuts in guide your course by the waves and *not by the wind*, for a wind often shifts about when the fog arrives.

If you have no compass and are in any doubt as to how you are heading, drop your sails and anchor at once, or if you can reach a buoy, moor to that until the fog lifts.

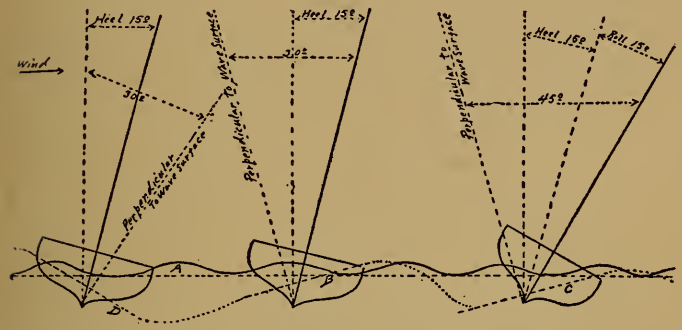
There is nothing much more perilous than sailing about blindly in a fog, for you are liable to sail in a circle, or far off your course, and when the fog lifts, if you haven't run aground or into another vessel, you may find yourself out of sight of land or many miles from your destination.

Always have a foghorn when sailing in localities where fogs occur and if for any reason you have no horn, shout halloo or beat on a bucket or a tin pan at intervals to warn other vessels of your presence.

Sometimes, if you climb to the masthead, you may be able to see above the fog or through it, for fogs are often thin a few feet above the water, and if you find this is the case your companion may be able to stay aloft and direct you, or you may be able to locate some landmark and to discover in which direction to proceed. If you see that the water is visible for quite a distance about and yet the fog is thick, you may be able to see a long way by leaning over the boat's side and peering ahead close to the surface of the sea, while if there are whistling or bell buoys in the vicinity these may serve to guide you.

Always proceed slowly and cautiously in a fog, for a reef or a vessel is likely to loom up close aboard at

any moment and you must be ever alert and have your boat under perfect control ready for any emergency. If there is someone with you, have him stand in the bow and report anything which he sees and *above all sound fog signals of some sort at intervals of not more than a minute* and if you hear another vessel's signals veer off and be sure you understand whether she is on the port or the starboard tack or is running before the wind.



EFFECT OF WAVES ON STABILITY

Sailing in heavy weather or in large seas is very different from sailing in smooth water and no one should attempt sailing a boat in strong winds or heavy seas unless thoroughly expert in handling a boat, or unless compelled to do so by necessity.

More accidents happen when running in a seaway than under any other conditions, for a boat which may be perfectly safe and stable in an ordinary sea, may capsize quickly if not handled with the utmost care and skill in large waves.

The effect of waves upon a boat's stability is seldom realized even by fairly competent sailors. This may be better understood by the accompanying diagram which represents a boat in waves as viewed in section and supposedly sailing with a beam wind in a sea running broadside on, A. If she is heeled to an angle of fifteen degrees, as shown, she would be perfectly safe, provided the surface of the water remained constant, but if a wave came from the leeward, or right, as indicated by the dotted line B, the angle would be suddenly increased to thirty degrees in relation to the waves' surface. Under normal conditions she might recover herself and swing back to fifteen degrees, or until her mast assumed the position shown by the vertical line, but long before she could so recover herself among the waves she probably would be swamped.

Moreover, in a sea a boat always rolls and if she is sailing at an angle, or heel, of fifteen degrees and rolls an additional fifteen degrees she is liable to capsize, and if her extreme roll occurs in unison with such a position as indicated in the diagram C, she would inevitably upset.

Even if neither of these occurrences took place there is the danger of a sea underrunning her and leaving the lee side unsupported, as indicated by the line D, and the wind, which has force enough to heel her fifteen degrees when properly immersed in water, would then force her to the capsizing angle as shown.

Aside from these dangers of the seas there is the added peril of a sudden gust or squall and if such a

sudden increase of wind strikes the sails when the hull is at its extreme leeward roll she will be certain to blow over. In this connection it should always be borne in mind that a wind which will only heel a boat to fifteen degrees when it blows steadily, may heel her to the upsetting point if applied suddenly. In other words, it is not so much the actual force of the wind which must be guarded against as the suddenness of its application.

Many amateur sailors seem to think that when sailing among waves danger may be guarded against by sitting on the upper, or windward, side of the boat or by shifting ballast to the windward side. This is a very grave mistake, for, as the boat rolls to windward when the waves run under her keel, the weight on the windward side may cause her to roll far enough to be swamped or it may prevent her from recovering quickly and the next wave may strike her bottom and turn her completely over. In addition there is the danger that she may swing her sail to windward, be caught aback and upset in a flash.

For these reasons *always* keep ballast, whether passengers or real ballast, as near the center of the boat and as near the bottom as possible when sailing among waves and decrease the canvas until she cannot heel at a dangerous angle. A boat may be sailed among waves many times and not upset merely because the conditions described do not happen to occur conjointly and yet the very next time she may capsize under apparently identical conditions. Hence, you should always use the greatest care when among waves and

should invariably shorten sail until you are sure you are safe.

Always try to avoid sailing with a beam sea, especially if the wind is also from the side, for this is the most dangerous of all conditions. A heavy sea may cause the boat to roll over, the sail may swing and spill the wind and allow her to be caught aback with her weather roll and to avoid a breaking sea which may swamp her, it will be necessary to swing her about for eight points, or at right angles, which cannot be done in a seaway in time to avoid swamping.

Never try to luff a boat up to a sea when in this position, but ease the sheet, swing her off and let the sea run diagonally under her keel. Remember that in waves a deep keel or a centerboard may prevent a great deal of the roll and even if running free keep your centerboard down, unless you find it causes her to steer badly.

If in order to reach your destination, it is necessary to run across a heavy sea with a beam wind you can avoid the danger of doing so by *quartering* or zigzagging—first heading up into the wind for a time and then turning and running with the wind on the quarter as shown by the diagram.

When running up the wind in this way you should luff right up into any heavy sea as it approaches, so as to take it bow-on, and the instant it has passed put the helm up, let the sails fill well and gather good headway to meet the next sea. Finally, when ready to go about choose a time when riding on the top of a

long, easy sea; swing her about quickly, ease off the sheets and use great care not to let the boat swing beam-on to the seas.

In puffs or squalls, and as you rise towards the crests of the waves, when running in seas, the boat should be luffed up and sheets eased before she is heeled rail-under, for if you wait too long she will answer her helm sluggishly and may capsize before she will luff to meet the sudden gust. *Don't* let her lose headway but as soon as the squall has passed or the craft has righted bear off again until the next puff comes along.

Almost as dangerous as sailing in a beam sea is running before wind and sea or "scudding" among waves, and many a good craft and many a valuable life has been sacrificed to carelessness or ignorance when scudding in a seaway.

The two greatest perils are *getting brought by the lee* and *broaching-to*. The former occurs when the boat's bow falls off to leeward by her stern being thrown to windward as a wave runs under her, while the latter is brought about by the head swinging into the wind and her stern off, thus causing her sail to "spill" with the result that she loses headway, swings broadside to the waves and upsets. Only the quickest and most expert handling can save a boat under these conditions and frequently she will refuse to come about or to answer her helm as she is raced along on the crest of a wave. If it is absolutely necessary to run before a sea, reduce sail, top the boom up well by the topping-lift or the peak halyards and stand ready to

haul in the sheet and to swing her into the wind or to ease her off instantly.

Keep the centerboard up, or halfway up is better, and devote every energy, every attention and every sense to handling your boat and pay heed to nothing else.

Even then there are many dangers to be guarded against. If sail is too greatly reduced your boat may lag between seas and a following wave may run over her stern and poop her; if there is a trifle too much sail or even if the sail is of the right area, she may scud off a wave and bury her bow in a preceding sea and be swamped, or her boom may catch in a sea as she yaws and thus capsize her.

If she shows signs of running too fast a drag, such as an oar, a thwart, a floorboard or even a cushion may be attached to a fairly long line over the stern and this will not only hold the boat back, but it will keep her steadier and will serve to prevent seas from breaking as well.

Oil thrown or dropped over the stern will also aid greatly in preventing a following sea from breaking over a boat's stern. Oil should always be on hand. It doesn't make much difference what kind of oil is used, but the heavier it is the better and only a very little is necessary; a wad of oil-soaked rag or cotton waste, or even oil squeezed from a sponge will often produce really marvelous results.

But the best and safest method is to avoid running before wind and sea by heading into the wind and running fairly free and then wearing ship and sailing

with a quartering wind and thus zigzagging over the course to be covered.

When sailing to windward against a sea there is comparatively little danger, if the boat is luffed up to meet the seas and is not allowed to lose headway. Then when ready to go about, if tacking, wait for an opportunity when there is a long, smooth-topped sea and swing the boat on the other tack quickly and stand ready to bring her about with an oar if she misses stays, for if she does this serious results may follow and she may be caught without headway, swung about and upset before you can get her under way again.

It is far less dangerous to handle a boat in a gale than in a seaway, but of course if the gale continues for any length of time the seas will rise. It is often far safer to ride out a gale than to attempt sailing in it, for few boats will fail to weather even a hard and prolonged gale and heavy seas if properly handled. If you have a sea-anchor or drogue aboard cast this over, lower or snug down sails, keep low down in the boat and if you have oil aboard allow it to drip over the bows. Under such conditions the drogue will break the force of the seas and keep the craft head to the wind and seas and the oil will prevent the crests from breaking over the boat. While she may rise and fall and pitch about tremendously there will be little real danger.

If the wind is blowing in a different direction from the seas or across them, lower and stow the sails, but if the wind is in the same direction as the seas a bit of canvas will often keep her steady and make her

ride more easily. With a boom-and-gaff sail the sail may be lowered until a very small portion remains and the rest of the sail should then be secured about the boom and the sheets trimmed flat. Sometimes a small triangular sail, such as a spare jib, may be set aft above the furled sail, while with a yawl or ketch rig the mizzen may be set and trimmed flat.

Above all things do *not* allow anyone to move about, to stand on the deck or to sit upon the gunwales of a boat in a heavy sea or in a squall, but keep all the weight as low and as stationary as possible. Always make everything snug and fasten all loose ropes and lines when riding out a gale or a squall, for trailing ropes, flapping sails and swinging lines are liable to cause trouble, aside from the fact that they will become tangled and will not run freely when wanted.

As a rule it will not be necessary to ride out a gale in a small boat for severe storms seldom come so quickly that sails cannot be reefed and shelter reached before the wind and seas rise until dangerous. Thunder storms and squalls, however, are often so sudden and unexpected that the amateur sailor has no time to run for a harbor and sometimes, when off a lee shore, it is dangerous to heave a boat to in order to reef. Under such circumstances great care and skill are required to weather the sudden blow in safety, especially when off a lee shore and everyone who handles a sailboat should be prepared for such events.

Have the sheet ready to let go instantly and drop the peak of the sail, if a boom-and-gaff rig, and if the boat carries a jib drop that.

If the squalls are light they may be seen approaching by watching the surface of the water, while if heavy or if they come when there is quite a sea running, the approach of the gusts will be indicated by white, scudding crests to the waves. Don't try to bear away or ease off the sheets to avoid these squalls but luff up slightly to meet them, allowing the luff of the sail to tremble but keeping the after part of the sail filled and by doing this and bearing off between squalls to gather headway a boat may be safely sailed through very heavy and frequent puffs.

If close to shore, however, or among reefs where there is little space for maneuvering, it is often impossible to luff into the squalls without danger of running aground and in such situations it will be necessary to ease off the sheet and flow the sail until the luff trembles, but *under no circumstances* should you turn and *run before* the wind when it's squally. As soon as your sail is before the wind you cannot prevent the full force of the puffs from hitting it without swinging broadside to the squall and if this is done there is a very great chance of upsetting the boat.

If on a lee shore you should of course luff up, for you must use every endeavor to *"claw-off"* the land. If you always remember the following simple rule you will seldom have trouble in weathering reasonable squalls. *Off a lee shore or where there is ample sea room, luff up to squalls. If off a weather shore or with obstructions to windward ease off for squalls.*

Finally, if you lower sails in a squall, be sure to spill the sail before lowering away, as otherwise it may

catch a puff of wind, balloon out and capsize the boat. If you wish to reef in squalls either anchor or throw out a drogue to keep head-on to the puffs.

If the squalls are very heavy and there is plenty of space to leeward lower the sails, throw out a drogue or anchor or scud before the wind under bare poles until the squalls decrease sufficiently to permit you to reef.

In handling boats an ounce of prevention is worth many tons of cure, and if you keep your weather eye open, as sailors say, there will seldom be occasion for you to face difficulties unprepared. Changes of wind or weather are almost invariably presaged by certain signs or symptoms which may readily be noticed and understood and everyone who sails a boat should learn to recognize the signs which indicate certain conditions.

Of course if one has a barometer the approaching weather conditions may be determined very easily, but even without this instrument a person who is weatherwise may usually foretell the approach of good or bad weather or of rain or wind many hours in advance.

Among the commonest and most noticeable indications are the following, and only in very rare instances will these signs fail:

Unusual twinkling of stars, Double horns to the moon, Halos around stars or moon, "Wind dogs".....	Increasing wind, or rain with a liability of wind.

Wind shifting from west to east	Increase of wind from the other direction.
Rosy sky at sunset	Fine weather.
Sickly, greenish-colored sunset	Wind and rain.
Dark red or crimson sunset.	Rain.
Bright-yellow sky at sunset.	Wind.
Pale-yellow, or saffron, sunset	Rain.
Mixed red and yellow sunset	Rain and squally weather.
Remarkably clear atmosphere with distant objects standing above the water and seemingly in air	Wind, usually from the northwest, and often rain.
Heavy dews	Fine weather.
Fogs	Change in weather and little wind.
Misty clouds on hills, remaining stationary, increasing or descending	Rain and wind.
Misty clouds on hills, rising or dispersing	Fairer weather.
Red morning sky	Bad weather and wind.
Gray morning sky	Fine weather.
High dawn (dawn seen above a bank of clouds)	Wind.
Low dawn (daylight breaking close to the horizon)	Fair.
Soft, delicate clouds	Fair and light winds.
Hard-edged, oily clouds	Wind.
Dark, gloomy sky	Windy.
Light, bright sky	Fine weather.
Small, inky clouds	Rain.
Light "scud," or small clouds moving across heavier clouds	Wind and rain.
Light, scudding clouds by themselves	Wind and dry weather.
High, upper clouds scudding past moon or stars in a different direction from the lower cloud-masses	Change of wind.

After fine weather a change is indicated by light streaks, wisps, or mottled patches of distant clouds which increase and join. A haze which becomes murky and clouds the sky also indicates a change to bad weather.	
Light, delicate colors, with soft-edged clouds	Fine weather.
Brilliant, or gaudy, colors and sharp, hard-edged clouds	Rain and wind.
A mackerel sky (small, separate, white clouds covering the sky)	Wet weather.
"Mares' tails" (long, wispy, curved, isolated clouds against a blue sky).....	Wind.
Rainbow early in the morning	Bad weather.
Rainbows in afternoon.....	Fair.

Many of these weather indications have become so widely known and universally recognized by seamen that they have been put into doggerel verse to make them more easily remembered and every boat sailor should learn these, for nine times out of ten they will prove true.

If wind shifts against the sun,
Trust it not, 'for back 'twill run.

* * *

Mackerels' scales and Mares' tails,
Cautious sailors shorten sails.

* * *

A mackerel sky
Seldom passes over dry.

Rainbow in the morning, sailors take warning.
Rainbow at night, sailor's delight.

* * *

Sun rising low and clear,
Bad weather do not fear.
Sunrise hidden, light on high,
Reef your sails for wind is nigh.

* * *

When the sun sinks bathed in gold,
Strong winds surely are foretold,
But if red the sun should set,
Then the morrow will be wet,
While if pink shows in the West,
Weather will be of the best.

* * *

If a ring surrounds the moon,
Wind and rain are coming soon.
Twinkling stars that brightly glow
Show that there will be a blow.

* * *

Sunrise red, bad weather ahead,
Sunrise gray, a pleasant day.

* * *

When the sea's against the wind,
Then your topsail halliards mind.

There are many more of these known to mariners, but the above are the most important and familiar and while the signs may fail at times yet it must be borne in mind that even the government experts, with their highly perfected and delicate instruments, are often at fault in their forecasts of the weather. With all our knowledge and scientific research, we really know very little about atmospheric conditions and changes and many an old sailor or fisherman can foretell fair or foul weather, wind or rain, almost as accurately as the trained observers of the Weather Bureau.

CHAPTER IX

BUILDING SMALL BOATS

Very few men or boys are capable of planning, drafting, laying down and building a round-bottomed boat. Even if you are expert enough to do this, the finished product will not compare to a boat built by a professional and it will cost far more, especially if time and satisfaction count for anything, than a readymade craft or one built to order.

There are many reliable firms which furnish patterns for all sorts of boats, from canoes and skiffs to schooner yachts and big power-cruisers. By means of these patterns and the directions which accompany them, any person who has patience and is handy with woodworking tools can build a boat. It is only necessary to mark off the patterns on the proper lumber, work the planks and timbers to shape and put them together according to directions, but even then you'll find some difficulties to be overcome.

These same firms also sell "knock-down" boats which have all the planks, timbers and other parts

sawed and formed, and by purchasing these it is a very simple matter to build a boat. Full directions accompany these knock-down boats and even the nails, screws, rivets and other fastenings and all the hardware and fittings are furnished if desired.

If you really *must* build a boat, the best plan is to look over the catalogs of these firms, select the model and size that suits you and then purchase the patterns or the ready-cut materials. You will no doubt obtain a great deal of pleasure and satisfaction by thus constructing your own boat, but your first attempts will not approach the boats built by men who have spent years at boat-building and have learned every little "kink" and trick of their trade.

In most places the cost of a readymade boat will be very little, if any, more than the one built at home by an amateur, but the fun of making it, the experience gained and the knowledge of using tools which you will acquire may make it worth while.

As a rule, however, it is not advisable to attempt to build a large, or even a medium-sized, boat and your first efforts at least should be confined to boats less than twenty feet in length. Even in craft of such small dimensions you will find there is plenty of hard, heavy work to be done. Planks and timbers must be steamed and bent; tough, hard oak must be cut, planed, chiselled and worked accurately and neatly. Many of the processes used in boat-building are different from those employed in any other form of carpentry and as a result a previous knowledge of woodworking may be of little value when constructing a boat.

But there are many boats which any handy man or boy can build easily and cheaply and which will prove safe, seaworthy and excellent sailing craft. These are the flat-bottomed boats, known as skiffs or sharpies, for a sharpie is really nothing more than a large skiff provided with a centerboard and with dimensions and lines designed to adapt it to sailing.

Before commencing to build any sort of a boat, however, you should have the proper tools with which to work, for without good tools it is impossible for a person to build even a simple flat-bottomed boat.

The tools required for building a boat are neither numerous nor expensive, but only tools of high grade should be purchased for a cheap or poor tool is an abomination and is almost as bad as none at all.

Of course, many people will have most of the required tools on hand, but for the benefit of those who do not the entire list is given as follows: A large ripsaw; a coarse crosscut saw; a fine crosscut or panel saw; a compass saw; a tenon saw; a hack saw.

The ripsaw should have about six teeth to the inch. The compass saw should be rather fine, about eight teeth to the inch. A miter saw and miter box will prove very useful in addition to the above.

Keep the saws bright and clean and when using them in gummy, pitchy or fibrous wood rub them with hard soap or chalk to prevent them from binding, but *do not* use oil as it will only make matters worse. *Never* stand a saw up so the blade bends and under no circumstances should you twist or bend the saw when sawing in order to pry or split off the wood. A saw which is

out of true, bent or sprung will bind and catch and will *not* saw straight.

You will also require several planes, such as a jack plane; a smoothing plane; a block plane; a rabbit plane. These may be of wood or iron as preferred and in addition you will find a bull-nosed plane, for planing in corners; a pair of matching planes and some beading or moulding planes very useful.

There should be several mortising chisels of 1 inch, $\frac{3}{4}$ inch, $\frac{1}{2}$ inch and $\frac{1}{4}$ inch sizes, and also two or three gouges varying from $1\frac{1}{2}$ to $\frac{3}{4}$ inch in size.

A good drawknife is almost essential, and a spoke-shave will prove very convenient.

A ratchet bitstock, or brace, is necessary and you should provide a good assortment of bits and augers to go with it. The best bits to use are those of twist-drill pattern, for these will not split the wood like ordinary gimlet-bits, and if you bore against a knot, a nail, a screw or any other metal object you can bore through it without injuring the bit. The bits should range in size from $\frac{1}{8}$ inch to $\frac{1}{2}$ inch in diameter, and the augers, which should be of the ship-auger pattern, should range from $\frac{1}{2}$ to 1 inch in diamter.

A breast, or hand, drill with assorted twist-drills will be useful and you should have several gimlets; at least two brad-awls; a countersink; a reamer, and a bit-brace screwdriver.

Extension bits, which can be adjusted to various sizes, are exceedingly useful and convenient, but are not absolutely necessary.

A medium-sized mallet; a claw-hammer; a small

hammer; two screwdrivers; a spirit level; a steel square; cutting pliers; compasses; a bevel gauge; a carpenter's gauge; a yardstick; a folding two-foot rule; an oil stone; wood rasps; flat or bastard files; a saw file; a carpenter's pencil; some iron carpenter's clamps; an old flatiron; a bench vise and a caulking-iron complete the list of tools.

In addition to all these you will need some benches or horses, a good workbench, screws, rivets, nails, etc.

Copper or galvanized iron nails and brass or galvanized iron screws should be used exclusively. Round "wire" nails will serve very well. Boat nails rivetted over burrs, clout-nails which are clinched, or plain copper nails will serve equally well, according to the purpose for which they are to be used. Where a nail is used to hold two pieces of wood together and does *not* pass entirely through, wire nails can be used to advantage, but if the nail goes entirely through both pieces, which is necessary to insure great strength, or where two thin pieces of wood are fastened together, rivets and burrs or clout-nails should be used.

Screws are to be avoided, for they require rather large holes, they often work loose and after getting them part way in they are liable to twist off or the slots may become so scarred that you cannot turn them out or in.

Next comes the question of material. If you purchase patterns or ready-cut material, the wood to be used will be determined by the directions furnished; but if you expect to plan and build a boat by yourself you will have to select and buy the lumber which is

best adapted to your boat and which can be most readily obtained.

For planking, white cedar, white pine, mahogany, yellow pine, basswood or cypress may be used. For frames, knees, stems and sternposts, transoms and ribs there is nothing better than good, clear white oak.

For making a flat-bottomed boat or sharpie, clear white pine or cypress is the best material for the planks; cypress or white cedar should be used for the bottom, and all the timbers, frames, transom and stem should be of oak.

The size and thickness of the various pieces of lumber will vary according to the dimensions of your boat, but for boats up to twenty feet in length, $\frac{3}{4}$ inch planking, 1 inch bottom boards and ribs, gunwales, deck timbers, etc., of oak 1 inch square will be strong enough. The transom should be of 1 inch oak, the deadwood may be of $1\frac{1}{2}$ or 2 inch oak or two 1 inch pieces bolted together; the keel should be of $1\frac{1}{2}$ inch oak, and the certerboard should be of 1 inch oak or yellow pine.

These are the extremes and the dimensions of timbers, ribs, centerboard and such parts may be reduced for smaller boats. Side planks $\frac{5}{8}$ or even $\frac{1}{2}$ inch thick will be very strong if more numerous ribs are used, and for small skiffs the bottom can be made of $\frac{3}{4}$ inch stuff and the ribs may be reduced to $\frac{1}{2}$ inch square.

It is a mistake, however, to make a boat too light, if it is to be used for sailing, for a reasonably heavy boat will have more headway, will handle better and will be more stable and seaworthy than a very light craft.

Before commencing your boat you should determine the exact dimensions. Until you are familiar with the principles of boat designing and have learned to figure out displacements, load-water lines, centers of efforts and resistance and many other technical details your best plan is to find some other boat that suits your ideas and copy her measurements.

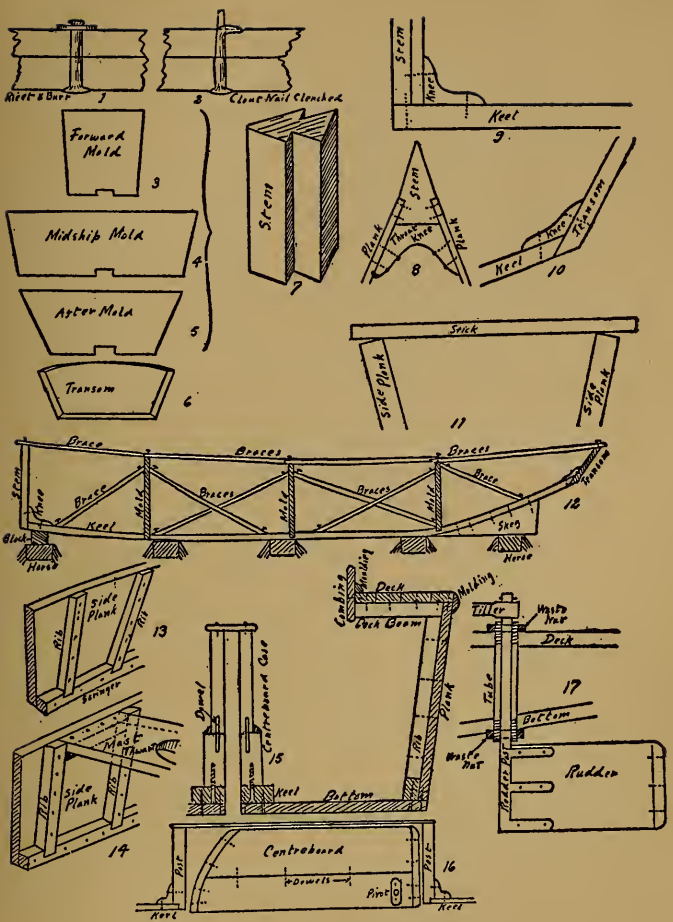
Once you have determined on the measurements you should mark them full, or at least half, size on a smooth, flat floor or some similar surface, as you will find it far more convenient to get out the various parts from such large plans than to work from small scale drawings.

As soon as you have these rough outlines and measurements ready you must make forms or molds. These may be sawed from planks or may be formed by nailing several pieces together, but in either case they must conform perfectly to the shape of the boat you have planned and both sides must be absolutely alike, for a very slight variation may ruin the sailing qualities of the boat.

These forms represent the section of the boat at amidships, near the bow and half-way between stern and amidships and their shape can easily be determined from your plans.

The transom or sternpiece should then be gotten out and the next work is to make the stem.

This will require care and time, for the sides must be cut away by chisel and plane until they will just receive the ends of the side planks neatly, and the angle of these depressions, or rabbits, must be determined by



Building a Flat-bottomed Boat

1–2—Boat fastenings. 3, 4, 5—Molds. 6—Transom. 7—Stem. 8—Stem and throat knee. 9—Stern fastened to keel. 10—Transom fastened to keel. 11—Lining up sides. 12—Molds in position. 13—Ribs. 14—Mast thwart. 15—Section showing construction. 16—Centerboard. 17—Rudder and post.

the angle at which the sides meet at the bow on the plan you have drawn.

When the stem, transom and molds are ready, take the piece to be used as a keel, cut the slit for the centerboard in it, and fasten the deadwood or "skeg" in place by means of bolts, screws and nails driven in from the upper side of the keel. Place the keel on the horses, with blocks beneath it to hold it at the proper curve, tacking them lightly to both keel and horses.

Fasten the keel in place by clamps and by tacking it lightly and secure the stem in position by means of a block or a knee. Fasten the transom at the opposite, or stern, end and set your molds at the points where they belong with the lower edges flush with the bottom of the keel.

Line up the center of the stem, molds and transom by a line stretched along them, arrange all the molds and the transom so they are parallel and exactly at right angles to the keel and secure them rigidly by means of light strips, or battens, tacked along their tops and brace them very securely by pieces running to the benches and keel.

Then take one of the side planks, clamp one end fast to the stem, so it fits snugly in the rabbit, and bend it slowly around the various molds to the transom and clamp it to each mold and to the transom. If you have someone to help you while doing this it will be far easier, for while one person holds or bends the board the other can secure it by the clamps.

Here, too, you will find why it was necessary to fasten stem, molds and transom firmly, for the entire

strain of the bending plank will come against them, and unless they are absolutely rigid the stem will swing to one side and throw the boat out of true. To prevent this it is a good plan to fasten braces from the top of the stem to the sides of the building where you are working, so that the stem cannot by any possibility be moved. When the plank is in position take a thin, straight strip, or batten, of wood, lay it along the upper edge of the plank—tacking it in position at the stem, at each mold and at the transom and mark along this to give the sheer curve at the top of the plank. Remove the batten and use it in the same way at the bottom of the molds.

Then take off the side plank, saw carefully along the marks made by the batten, cut the other plank exactly like it and replace it, securing it first by clamps, and then by boat nails driven through it into stem and transom and tack it lightly to each mold. In driving the nails be sure to drill holes through the plank first, as otherwise it may be split.

When both planks are in place, lay a straight stick across from side to side and plane down the upper edges of the planks until the stick rests squarely upon the edges of both planks, instead of on one corner of each, as it will do at first. When both sides are bevelled place the various frame or rib pieces on the insides of the planks, spacing them about 1 foot apart, measuring along the curve of the sides, and being sure to keep them parallel and leaving a space of $1\frac{1}{2}$ inches between their lower ends and the bottom edges of the planks. Secure them by means of rivets and burrs,

with the burrs on the inside, or by means of clout-nails clinched over on the inside and use the old flatiron, held against the head of each nail or rivet as you burr or clinch them with the hammer.

Saw each rib off at the top, just even with the planks, and then fit a good stout piece of oak or *throat knee* between the planks and stem at the bow and fit two other knees at the corners of the planks where they join the transom.

At the spot where the mast is to be stepped secure a strong, oak crosspiece, or thwart, with the mast hole cut in it, across from one plank to the other by nailing, or bolting, pieces across the ribs just the thickness of the mast thwart *below* the upper edges of the planks. Bolt or screw the mast thwarts to these and then secure a block, with a hole in it, to the keel directly under the mast hole in the thwart.

If the boat is to be open you can place another thwart across the stern, but if it is to be decked, or partly decked, the other thwarts can be put in just as well later on. The next step is to make the centerboard and its case and place the latter in position.

The centerboard case is made by securing two pieces, known as *trunk-logs,* to the keel, using white lead and strips of canton flannel or thin felt under them and drawing them tight to the keel by means of long screws run up from below. Of course, it will be necessary to curve the lower edges of these pieces to fit the keel snugly before putting them in place.

Then rivet the ends of these to the upright posts at the ends, which should also be set in white lead and

screwed to the keel, and then build up the case by other boards to a height well above the water line. The board itself may be made either of several pieces of wood or a single piece. In the former case the strips should be dowelled together and a transverse strip should be placed at each end to prevent the pieces from separating, while if one piece is used, end pieces should be fastened on to prevent the plank from warping or splitting. The board should be pivotted by running a brass bolt through the two sides of the case and the board with a piece of pipe, an old rowlock socket, or some similar "bushing" in the board to prevent the hole in the wood from wearing.

The board should be hung so it can be raised and lowered easily. In order to do this, the pivot should be near the lower front corner, and the upper rear end of the board must be rounded or slanted off so it will swing up into the case.

The top of the case may be left open or a piece of board may be fitted over it with a hole for the rope or chain which is used to control the board to pass through. Be careful to adjust this chain, or rope, so the board cannot drop too far as it should not fall beyond the perpendicular.

The next step is to place light, diagonal braces across from side to side and from molds to side planks, tacking them lightly in position, and then remove the braces and clamps from the keel. Lift the boat from the benches, turn it upside down and plane off the lower edges of the planks until square as you did the upper edges.

Then fit a piece of oak along the lower edge of each side plank, cutting little notches in it to fit around the end of each rib. Rivet these to the sides, plane off the bevel to bring these pieces true with the edges of the planks and you are ready to put on the bottom planking.

The bottom may be run either lengthwise, or crosswise, on a flat-bottomed boat, but if run lengthwise cross timbers are required, which are a nuisance, and the crosswise planking does just as well and is far easier to make.

Place a piece of the bottom planking across the bow, covering the stem and extending a short distance on either side of the side planks. Smear the lower end of the stem, the keel and the side planks with thick white lead and nail the piece securely into the stem, the keel and the two oak pieces along the sides and to the side planks also. In driving these nails be sure and set them at an angle to correspond with the slope of the sides, or else they will split out and cause your boat to leak.

Fit another cross plank behind this with plenty of white lead between the edges and secure it in place. Continue in this way until the slot for the centerboard is reached. Here the planks must be run from each side of the slots to the side planks, and where the deadwood, or skeg, is fastened the same method must be followed.

When the bottom is fully planked saw off the projecting ends close to the sides, being careful to keep the same angle and not to scar or cut the side planks,

and then, with the block plane, smooth the ends evenly with the side planks.

When this is done fit a false keel, or rubbing-strake, along the center of the bottom with a slot cut in it to correspond with the centerboard slot and taper it at the rear to fit the lower surface of the deadwood. Smear the under surface of this, as well as the bottom where it rests, with thick copper paint and nail firmly in place. And *don't* forget to paint *all* the inside portions and joints of the centerboard case, as well as the board itself and the inside edges and slot in the keel, with copper paint before putting them together.

You can now turn your boat over, knock out the molds and finish with the decking or other interior arrangements, but before taking out the molds you should put the deck beams in place, if a deck is to be used, or should place thwarts across from side to side, if the boat is to be left open.

For a small, simple boat the deck beams may be run straight across from side to side and the cockpit may be made rectangular, with the forward end pointed or V-shaped. The deck may be made by nailing narrow strips along the timbers and following the curve of the sides, or wider planks may be nailed lengthwise and trimmed off to make a smooth, even edge with the sides, after which a covering board should be nailed over the joint and a strip of half-round molding should then be run along to protect the edges from being injured, as well as to give a good finish to the boat.

The edges of the cockpit should be finished by oak combing nailed to the deck and timbers, and a quarter-

round molding should then be run around the outside where the combing and the decks join.

If the deck is carefully made and laid in white lead, it will be tight, but if desired it may be covered with canvas laid in paint and with the edges folded down over the sides, trimmed closely and concealed by the molding.

The rudder should be made of either wood or metal. For a small boat, brass or galvanized iron is the best. It should be hung *under* the stern by means of a post run up through the keel and after deck. To prevent water from entering, a piece of brass tube, or pipe, threaded at both ends, is run through the hole, and set up closely by means of "waste-nuts," after which the ends of the pipe should be filed off smoothly and slightly rivetted or burred over to prevent the nuts from coming loose.

If you succeed in building a sharpie, as directed, you can attempt a V-bottomed, or skipjack, boat or a dory, for the principles involved are the same in all, but space will not permit a full description of how to construct these. You can obtain a far better idea of how they are built by examining a boat and studying its various parts than by reading many pages of text.

Finally let me warn you not to attempt to build any boat, not even a small, flat-bottomed skiff, unless you possess patience and perseverance and are willing to take plenty of time and painstaking care. No boat that is worth building can be made by slap-bang, careless, slack methods. Boat-building is something which cannot be hurried, for the finished result depends very

largely upon little things and attention to details. To watch a boat-builder, one would think that he did his work by guess and took little care, but in reality he does everything in a certain order and a certain way. His apparent carelessness is really expertness, for he has done exactly the same thing so many times that it becomes second nature and is almost involuntary.

If there is a boat-builder in your vicinity visit his shop, watch him by the hour, note the way he handles his tools and the order in which he shapes the parts and puts them together and your time will be well spent. It's the best possible way to learn the details of boat-building.

CHAPTER X

WHAT NOT TO DO

In learning to sail a boat or when handling a boat after you have learned to sail, there are certain things you *should* do and many other things you *should not* do and of these the latter are perhaps the most important.

In the first place *don't* try to learn to sail by using several different boats. Every boat has its peculiarities. If you use one boat on one day and another the next you will be confused and will be unable to make rapid progress, for one craft will sail to best advantage with the sails trimmed in one way and the very next boat you use may require very different treatment. One boat will sail closer to the wind than another, one will luff more quickly than another and one will come about readily every time, while the next may miss stays under the same conditions. Still other boats require special arrangements of ballast, a certain amount of centerboard or a definite trim in order to behave well and you must learn every whim and

caprice of your craft to become expert in handling her.

Don't try to learn to sail in a large boat or one with many sails or complicated rigging. Begin with a small craft with a single sail of the simplest pattern. When you are thoroughly familiar with this you can attempt handling larger boats with head-sails.

Don't take your first lessons in a strong wind, in rough weather, or when there are signs of thunder storms, squalls or fogs. Select the very best weather for you'll have plenty to attend to without looking after the elements.

Above all, *don't be afraid to be afraid.* Many a man is considered brave merely because he doesn't know enough to be afraid, but real bravery consists in realizing danger, being afraid of it and yet facing it calmly, deliberately and with intelligence.

Don't be afraid of the opinions of others, if you think you should shorten sail reef at once, even if everyone else is carrying full sail and people laugh at your caution.

Don't be afraid to fear squalls, fogs, gales or heavy seas for they are all treacherous and the more you fear them the more likely you'll be to safeguard yourself, your passengers and your boat.

Don't be afraid to refuse to go sailing if you think a squall, storm, or fog is coming up, or if you think the weather too bad. It's better to be scoffed at and called a coward than to be shipwrecked or drowned. A live coward's better than a dead bravado any day.

Don't be afraid to assert your authority. The cap-

tain of any craft is supreme aboard his boat and there should be no questioning of his orders or decisions.

Don't take anyone with you who is nervous, cranky, hysterical, overbearing, grouchy or a "know it all." Such people spoil all the pleasure of a sail, they are a nuisance and in times of danger they often become a real menace to others. If they know more than you do, or think they do, they should be handling their own boats, not going as passengers in yours.

Don't take anyone with you as a passenger until you are competent to handle your craft under any and all conditions. You have no right to imperil the lives of others.

Don't take out a party unless there are life-preservers enough for all. Accidents happen to the best of sailors.

Don't try to sail or handle a boat until you know how to swim.

Don't set out on a sail without oars, compass, water, anchor and at least one life-preserver on board.

Don't jump, run, wrestle or skylark in a sailboat.

Don't allow anyone to sit upon a rope or line which may be used at any moment.

Don't permit passengers to sit or stand on the bow or bowsprit unless for the express purpose of keeping a lookout.

Don't tie or make the mainsheet fast. Hold it in your hand with a single turn about a cleat, so it can be released instantly.

Don't try to show off by carrying all sail in a blow

or in squalls. Reef before it's too late. It's easier to shake out a reef than to put one in.

Don't sail across or close to the wake of steamers to "get" their waves. It may result in the boat capsizing and only shows you are a landlubber and a fool.

Don't start out in the face of a storm, gale or squall. Wait until you are sure of what is going to happen and then reef close if you must go forth in a blow.

Don't forget that you cannot judge the force of the wind or the size of waves from the shore.

Don't brag about "liking to sail in storms." Real sailors cannot have weather too fair.

Don't sail in fogs unless you have a compass and are sure of your course.

Don't try to sail too close to reefs, to other vessels or any other obstructions; something may fail at the last moment and a collision or wreck may result.

Don't forget that when sailing close to land sudden puffs or squalls are more frequent than in open water.

Don't forget that another vessel, a rock, or the shore cuts off the wind and may cause you to lose headway and then when beyond the object the wind will strike you suddenly and perhaps with dangerous force.

Don't fail to keep everything shipshape and orderly about the boat. A snarled or kinked line is a menace to life and limb.

Don't sail with water in the boat. Water is so much shifting ballast and is dangerous, besides being unpleasant and unnecessary. Bail the water out and keep it out.

Don't try to save a few cents by using old, rotten, or frayed ropes. New rope is cheaper than human lives.

Don't use a leaky boat. If a boat leaks a little in smooth water it may leak fast enough to sink when in a seaway.

Don't sail at night without lights. You are endangering yourself and other sailors as well.

Don't assume that the "other fellow" knows how to sail and is familiar "with the rules of the road." He may be more ignorant than yourself.

Don't wait too long before turning aside for another boat. Shift your helm to show your intentions.

Don't try to sail too close to the wind. You'll reach your destination more quickly by sailing a few points off and thus traveling faster.

Don't run dead before the wind if it can be avoided, especially in a seaway.

Don't sit on the lee side when sailing on the wind.

Don't climb up on the masts or into the rigging unless it is necessary. A man's weight at the top of a mast may cause the boat to capsize.

Don't lash or tie the helm under any circumstances.

Don't leave a lowered sail unfurled. It ruins the sail and is dangerous.

Don't try to run to a mooring or a landing before the wind when under sail. Lower the sail and run in under bare poles or row in.

Don't fail to take the advice and suggestions of more experienced boatmen.

Don't take others sailing until you are thoroughly

familiar with the boat and know how to handle it under all conditions.

Don't anchor or moor a boat where she will rest on a hard, rocky or uneven bottom at low water.

Don't overload your boat.

Don't sail in strange waters without a chart or a pilot.

Don't lose your head or get "rattled." Keep cool and use your brains and common sense.

Don't fail to keep your gaze to windward. Seas and wind puffs come from that side.

Don't neglect the boat or allow your attention to be distracted by your companions.

Don't attempt to tack or go about with a large wave rolling on your weather bow. Wait for a smooth, or when on the summit of a long, easy roller.

Don't jibe if it can be helped. It's just as easy and far safer to wear ship.

Don't luff a boat sufficiently to stop her headway. Keep steerage-way at all times.

Don't try to cross another boat's bows if she is under way.

Don't get frightened if the boat upsets. Crawl up on the bottom over the weather side. A capsized boat will support a number of people in perfect safety.

Don't take to the water if there is any floating object to cling to. Even an oar will support a person.

Don't let go of the helm and run about.

Don't let sails, ropes or garments trail in the water.

Don't forget that a loaded or heavy boat has more momentum or headway than a light or empty boat.

Don't trust a squall which you cannot see through.

Don't use a brand new rope for any part of the running rigging. Stretch it and work it through tackles or over a beam before reeving it through the blocks of your boat.

Don't sail in a beam wind and sea if it can possibly be avoided.

Don't forget that if you are obliged to ride out a gale that oars, cushions, thwarts and spare canvas lashed together and attached to a line over the bow will hold the craft to the wind and seas and will also form a "smooth" for the boat.

Don't under any circumstances allow liquor aboard your boat. If your friends *must* drink spirits let them stay ashore to indulge themselves. They have no place in a boat.

SOME NAUTICAL TERMS AND THEIR MEANINGS

Aback. A sail is said to be aback when its forward side is acted upon by the wind.

Abaft. A position toward the stern from any stated point.

Abeam. At right angles to the line of the keel.

About. To go from one tack to the other.

Adrift. Broken loose or uncontrolled.

Aft. Towards the stern.

A-lee. To the side of the craft opposite the wind. To the leeward side.

All in the wind. When the sails have the wind edge-on and shake.

Amidships. In the middle. In line with the keel.

Athwartships. Across the boat. At right angles to the keel.

Avast. An order to stop or discontinue anything.

A-weather. The side towards the wind; to the windward side.

Backstays. Stays or shrouds leading aft to support a mast or topmast.

Bear up. To turn from the wind.

Belay. To secure a rope about a cleat or pin.

Bend. To make fast. A kind of knot.

Berth. An anchorage or mooring. A slip or place where a boat rests at a dock. A sleeping place.

Bight. A curve, noose or slack portion of rope.

Bitts. Upright pieces of timber or metal to which ropes or cables are fastened.

Blocks. Contrivances with sheaves or rollers through which ropes are passed to make them move readily.

Block and block. When two blocks of a tackle are brought as close together as possible.

Block and tackle. Blocks with the ropes rove through them.

Board. The distance made on a tack.

Bobstay. A stay from the cutwater to the bowsprit-end.

Bolt rope. The rope sewn around the edges of sails.

Boom. A spar at the bottom or foot of a sail. A spar extended from a vessel's side to which small boats are fastened. A raft of logs in a river fastened together to hold other logs in place.

Bowline. A line used on square sails to extend the forward edge of the sail when running close to the wind. To Sail on a Bowline is to sail close to the wind.

Bowse. To haul upon.

Bowsprit. A spar extending forward from the bow.

Brails. Ropes for drawing up a sail to the mast in order to furl it.

Bring to. To come to an anchor or mooring.

Bull's eye. A piece of wood with a hole in the center through which a rope may be passed.

By the head. To be deeper in the water at the bow than at the stern.

By the wind. As near the wind as the boat will sail without the sails shaking; also called Full and By.

Cable. A line or chain by which a vessel is anchored or moored. A left-handed-laid rope.

Capsize. To upset. To loosen a knot.

Carry away. To break or tear loose.

Cast off. To untie; to free.

Casting. To pay a vessel off on the desired tack.

Cat's paw. A light puff or current of wind seen on the surface of the water. A kind of knot or bend.

Chock a block. See Block and Block. Also used to denote fully laden.

Cleat. A metal or wooden object to which ropes are fastened.

Clew. The after corner of a fore-and-aft sail. The two lower corners of a square sail.

Close hauled. Sailing as nearly as possible into the wind.

Cockpit. The open after part of a boat.

Course. The direction in which a boat is to proceed. The lower sails on square-rigged vessels.

Crank or cranky. Not stable. Unable to carry sail well. To tip easily. Unsteady.

Cringle. A thimble or eye worked in a sail and

through which a rope may be passed.

Crotch. A support of crossed pieces of wood, or metal, in which the boom rests when the sail is furled.

Cutwater. The extreme forward edge of the bow.

Davits. Curved iron or wooden objects to which boats are hoisted.

Downhaul. Rope used to haul down sails.

Dowse. To lower rapidly. Also to extinguish.

Draught or draft. The amount of water in which a boat is immersed when afloat.

Earrings. Lines passed through cringles.

Ease off. To slacken.

Ensign. The national flag of any country.

Entrance. The lower part of a vessel's stem.

Fag end. The end that is frayed.

Fall off. To move away from the wind.

Fathom. Six feet.

Fid. A sharp, tapered tool used in splicing rope.

Fill away. To have the wind fill the after surfaces of the sails and the vessel proceed on her course.

Fore reach. To pass to windward of another vessel when close hauled.

Foul. Anything entangled. To come into contact.

Furl. To stow a sail.

Gaff. The spar that supports the top of a fore-and-aft sail. A pole with a sharp hook on the end.

Gangway. The place where people come aboard. An opening in a vessel's side. Room to pass.

Garboard strakes. The planks next to the keel on a boat's bottom.

Gasket. A lashing of rope or a strip of canvas used to secure sails, etc.

Go about. To tack. To alter the course so the sail fills on the other side.

Grapnel. A four-pronged anchor.

Griping. Carrying a hard weather helm.

Grommet. A ring of rope. A metal ring used in place of an eyelet in a sail.

Ground tackle. The anchor, cable and fittings.

Halyards or Halliards. Ropes used to hoist sails.

Handsomely. Carefully, smartly.

Handy billy. A small tackle used in hauling on a rope.

Hanks. Metal rings for attaching sails to stays so they will slide easily.

Heave to. To stop a vessel's movement by so arranging sails that she will lie head to the wind and almost stationary.

Heeling. Tipping to one side.

Hitch. A kind of knot.

In irons. When headway is lost and the boat will not answer her helm.

Jammed. Any rope or other object caught so it will not move or cannot be readily freed.

Jib. A triangular sail set between the mast and bowsprit.

Jibe or Gybe. To let the mainsail swing from one side to the other when running free.

Jury mast. A temporary mast to replace a mast which has been carried away.

Jury rig. Sails set on jury masts.

Kedge. A small anchor.

Leech. The after edge of a fore-and-aft sail. The ends of a square sail.

Lee helm. When a tiller or helm must be held to leeward to prevent the boat from falling off the wind.

Leeward. The direction toward which the wind is blowing. Away from the wind.

Leg. The distance sailed on a tack in one direction.

Log. An instrument used to measure a boat's speed or the distance travelled. A record of the ship's travel and what has been done each day. A book in which the log is kept.

Long leg. The longest course sailed when tacking.

Luff. To bring the boat's head to the wind. The forward edge of a fore-and-aft sail.

Lying to. Heading close into the wind under reduced sail so as to remain practically stationary.

Missing stays. Failure to come about when tacking.

Moor. To secure by anchors or cables.

Moorings. A spot where a vessel is kept when at anchor.

Mouse. To secure by means of spun yarn or line to prevent its becoming detached. A seizing about a hook.

Off and on. Approaching on one tack and bearing off on the other especially when approaching or near land.

Offing. Out to sea. Sea room.

Overhaul. To slack up a rope and haul it through blocks. To straighten out a line and arrange it. To examine and make right. To overtake.

Painter. The line by which a boat is made fast and which is attached to the bow.

Part. To break or pull apart.

Pay. To coat with pitch or tar. To let out rope or cable.

Pay off. To recede from the wind. To bring a boat's head around to catch the wind.

Pendant. A short piece of rope.

Pennant. A narrow flag or streamer.

Pooped. To be struck by a sea which comes over the stern.

Port. Left hand. Also sometimes called Larboard.

Preventer sheet. A sheet used to relieve unusual strain.

Preventer stay. A temporary or movable stay set up to relieve a strain on the rigging under certain conditions.

Quarter. Part between beam and stern.

Rake. The lean or cant of a mast or other object from the perpendicular.

Reaching. Sailing with wind abeam.

Reef. To reduce the area of a sail. A line or group of sunken rocks.

Reeve. To run a rope through anything.

Rooting. Burying by the head.

Run. The submerged afterpart of the hull.

Scud. To run before a wind. A kind of cloud.

Seize. To make fast or bind.

Selvage. A strap made of yarns loosely bound together.

Sheave. The wheel within a block or any wheel over which a rope runs.

Sheer. To vary from a direct course. The curve from bow to stern horizontally.

Sheet. A rope attached to a sail and by which the sail is held and worked. On a square sail, ropes which spread the sails.

Snorter or snotter. A rope strap into which the heel of a sprit is slipped.

Soldier's wind. A beam wind.

Spill. To throw the wind out of a sail.

Splice. A method of joining two objects together so the joint is no larger than the rest of the object.

Spring. To crack or bend a spar. A rope made fast to a cable, to some spot ashore, to a buoy or mooring, or to another vessel and then led aft in order to swing a vessel's stern in any desired direction. To start a plank. To start a leak.

Sprit. A light spar used to extend a sail.

Squatting. Settling down by the stern.

Starboard. The right-hand side.

Stay. A rope or wire used as a support to a spar.

Sternboard. To move backward stern first.

Tack. To proceed against the wind by zigzags. The forward corner of a fore-and-aft sail.
Tackle. Any arrangement of ropes and blocks.
Taut. Tight.
Truck. The top of a mast.

Unbend. To cast off; to unfasten.

Veer. To turn. To pay out cable.

Wake. The track left by a vessel in the water.
Watch. A division of the crew. The length of time a man is on duty.
Wear. To turn a boat's head into the wind and then around until she has the wind on the opposite side.
Weather helm. When a tiller or helm must be kept to windward to prevent a boat from flying into the wind.
Weathering. Surviving anything, such as a gale or storm. Getting to windward of anything.
Weigh. To hoist or lift, especially to lift the anchor.
Wind's eye. The exact direction from which the wind blows.

Yaw. To swerve wildly or violently from a true course despite the action of the rudder.